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*Advertisement Index, see page xxviii.*

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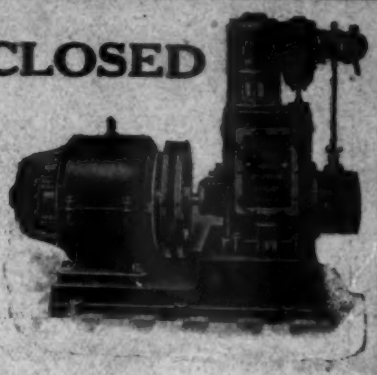

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## ELECTRICAL REVIEW.

Vol. LXXXII.] CONTENTS: January 11, 1918. [No. 2,094.

| | Page |
|---|---|
| The Report of the Coal Conservation Sub-Committee ... ... | 25 |
| Electric Motors in Germany ... ... ... ... ... | 26 |
| Reminiscences.—II., by "Ex-Shift Dog" ... ... ... | 27 |
| Some Considerations on the British Electrical Industry after the War, by E. S. Hodgson ... ... ... ... ... | 28 |
| A Novel Transformer Analogy, by C. W. Marshall (*illus.*) ... | 29 |
| Gas Firing Boilers ... ... ... ... ... ... ... | 29 |
| A New Type of Enclosed Motor (*illus.*) ... ... ... | 31 |
| The Lubrication of Air Compressors and Diesel Engines ... | 32 |
| Correspondence— | |
| Proposed Institution of Electrical Station Engineers ... | 33 |
| Illuminating Engineering ... ... ... ... ... | 33 |
| Meters on a Changed Frequency ... ... ... ... | 33 |
| Distinctive Colours for Braided Cables ... ... ... | 33 |
| The Production of Ductile Tungsten ... ... ... | 33 |
| Electrically-Driven Cement Works (*illus.*) ... ... ... | 34 |
| War Items ... ... ... ... ... ... ... ... | 35 |
| Business Notes ... ... ... ... ... ... ... ... | 35 |
| Notes ... ... ... ... ... ... ... ... | 39 |
| City Notes ... ... ... ... ... ... ... ... | 43 |
| Stocks and Shares ... ... ... ... ... ... ... | 44 |
| National Electricity Supply (*concluded*) ... ... ... | 45 |
| West of Scotland Linking-up ... ... ... ... ... | 46 |
| Trade Statistics of the Straits Settlements ... ... ... | 47 |
| The Röntgen Society ... ... ... ... ... ... | 48 |
| New Patents Applied for, 1917 ... ... ... ... ... | 48 |
| Abstracts of Published Specifications ... ... ... ... | 48 |
| Contractors' Column ... ... ...Advertisement page xxii | |

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## THE REPORT OF THE COAL CONSERVATION SUB-COMMITTEE.

WE dealt at some length, in our leader of last week, with the general aspect of the far-reaching proposals contained in the above report. Needless to add, the carrying-out of these proposals will necessitate the practical solution of many technical questions of a highly controversial character, and, as is almost inevitable in such cases, we shall probably arrive at a compromise, of a more or less acceptable nature, but representing something very different from the picture which one might conjure up in imagination after a perusal of the report. The Sub-Committee, in its desire to emphasise the ideal, has, perhaps intentionally, glossed over the technical and financial features of its scheme, which, however desirable, will not appeal to the engineer unless its practicability can be demonstrated.

Many of the recommendations contained in the report may be assumed to be based on experience gained by the North-East Coast Power Companies, and, without detracting in any way from the excellent work carried out in that super-electrical area, one may question whether the conditions obtaining there can be reproduced in more than one or two other areas. The Tyneside district certainly offers a specific example of unified control on a large scale of a number of interlinked generating stations, the two largest of which, however, fall considerably short of the size of super-station defined in the report, and this despite the intensive electrical development of the area, in which some 350,000 H.P. is connected to the system.

Admitting, however, that we shall of necessity concentrate our generating capacity in large-unit plants, the question of sites for the latter arises. Every engineer will agree with the desirability of building these large stations on important waterways, as suggested in the report, in order to obtain adequate condensing facilities, if the additional cost of coal transport and electrical transmission does not render that course impracticable. Several of our leading municipal undertakings have made arrangements to erect large generating stations—of the order of 100,000 KW. or more—and as regards those situated inland and adjacent to colliery districts, the question resolves itself into the relative cost on the one hand of transmitting 100,000 KW. over a distance of, say, 20 to 40 miles, from the nearest suitable waterway, or, on the other, of artificially cooling the condensing water on the inland site. In any case, inland waterways of the size required for the type of super-station indicated in the report are few and far between, while in some in-

stances their use would involve considerably increased coal transport—an important matter where the annual tonnage runs over the hundred thousand—as well as extra transmission cost.

It has to be remembered that the modern power station has been a product of evolution; the all-big-unit plant has only become possible where it is projected, because the load conditions have been suitable; and as super-stations of any kind cannot profitably be brought into use until the necessary load is available—and existing turbine stations are unlikely to disappear until their operating performance can be bettered—it is evident that the general use of such big stations will be a question of time and circumstances, on which the financial questions involved will have an important bearing.

The report is somewhat obscure on these points, as we gather (*a*) that "the linking-up of adjacent power stations should be encouraged," as a step in the direction of greater economy, provided it is appreciated that it is only a step; (*b*) that the proposed electricity commissioners should at once make "arrangements" for the generation of power on a large scale, preferably from super-stations; and (*c*) that plans should be prepared for the construction "immediately after the war" of the first instalment of large super-power plants.

Apart from the question of providing acceptable controlling bodies for the proposed areas of supply, the necessity of dealing firmly with the programme of future construction appears to be one of the most pressing matters of the moment.

Exception will doubtless be taken, in municipal circles, to the comparison of average prices charged by electrical authorities in the Lancashire area with the average price obtaining on the North-East Coast system. The figures for private and total supply are misleading, because the proportion of domestic and small power users to the total is far greater in the general run of local undertakings than in the case of the North-East Coast area, where bulk supplies preponderate; on the other hand, it is precisely this preponderance of bulk supply which gives us a true indication of the fuel economy in the area, with which, of course, the Sub-Committee is primarily concerned. It will be noted, however, that some Lancashire towns (Stockport .8d., Bury .72d., Ashton .85d., Stalybridge .66d.), despite their comparatively small areas and outputs, supply at prices which, all things considered, bear comparison with those on the North-East Coast, and doubtless from the same cause, *i.e.*, the great preponderance of power supplies in large blocks.

Too much importance must not be attached to these isolated examples of low average total cost; the North-East Coast prices evidently work out at a still lower average for industrial purposes, and that over a very large area, which is of greater importance to the welfare of the electrical industry as a whole than low prices in individual localities.

The estimates of fuel saving in the report are based on the assumption that on the average 5 lb. of coal is consumed per H.P.-hour at the present time. On the North-East Coast it was found that an average of 7 lb. had been used, but colliery areas are notoriously wasteful of fuel, and in the textile districts of Lancashire and Yorkshire, which are probably the largest power consumers in the country, it seems probable that considerably under 5 lb. per H.P.-hour is used. The Bradford city electrical engineer has, in fact, given figures which he has obtained from 18 different textile works covering the staple trades of the district, and using over 28,000 I.H.P., which show an average coal consumption of only 2½ lb. per H.P.-tour. These figures are presumably obtained from large installations, and the question will naturally be asked whether they are representative of the textile districts as a whole. To put the matter in another way, is the Sub-Committee justified in basing its estimates for the whole country on an average of 5 lb. of coal per H.P.-hour, when what was probably one of the most wasteful districts only required an average of 7 lb.?

One of the most important factors in the development of electric power supply on the gigantic scale contemplated by the Sub-Committee is the question of wayleaves, to which we have repeatedly drawn attention in these columns. The provision of statutory facilities for carrying overhead lines across country is an absolute *sine qua non* to the success of the scheme, particularly in the case of trunk lines operating at pressures of the order of 50,000 or 100,000 volts, which will be necessary if the generating stations are situated at a considerable distance from the areas where the supply will be utilised. Whether such a line be erected on a special right-of-way acquired for the purpose, as in the United States, or carried across land in private ownership, the difficulties of which Mr. Vernier gave such striking examples in his paper before the I.E.E., will present insuperable obstacles without the intervention of the Legislature. Even if the Sub-Committee's proposals had not been put forward, the solution of this problem would have remained of vital importance to the electricity supply industry. We are told by Dr. Addison in a prefatory note to the Report that the legislative aspects of the whole matter are being investigated by the Board of Trade Committee on Electric Power Supply, and we trust that no effort will be spared by the leaders of the industry to impress upon the Committee the extreme urgency of this question, which is essentially one that can be adequately dealt with only by *ad hoc* legislation.

**Electric Motors in Germany.**

SOME time ago we referred to the introduction of compulsory notification by makers and owners of dynamos and motors in Germany, with the object of their being requisitioned by the military authorities as occasion might arise. Now a fresh notice has just been issued, intimating that inquiries have resulted in the discovery that many motors which ought to have been reported have been withheld by the owners, possibly in ignorance of the order issued in June last.

The notice lays emphasis on the fact that a return must now be made of all motors of an output of 2 H.P. and upwards, excepting those which are used in establishments engaged on war work, and those used for the operation of lifts which are in regular service. If advantage is not taken of the present opportunity, those persons who neglect to make a return are threatened with the legal penalties provided under the law, in the event of further inquiries resulting in the finding of non-reported motors. It would appear from these circumstances that the comparative scarcity of copper, in face of the great demand, is reaching a stage when the dismantling of motors will have to be taken in hand, although it has to be borne in mind that the peace-time copper production of Germany was approximately 42,000 tons per annum.

## REMINISCENCES.—II.

By "EX-SHIFT DOG."

"EXPERIENCE teaches," so the proverb avers, and frequently mistakes in operation call attention to deficiencies in design or equipment, and cause alterations which not only prevent the repetition of the mistake, but tend to promote more reliable running thereafter. But also experience wrongly understood causes much trouble, and it is necessary thoroughly to grasp the whole circumstances of the case before arguing general principles from a particular experience. A certain station used pumice-stone freely and satisfactorily for polishing the commutators of both reciprocating and turbo-generators, and, misled by this, the writer applied carborundum stone in like manner to the surface of a direct-coupled turbo-exciter, with the result that the sparking and vibration it was hoped to cure were made very much worse. The harder abrasive was successful eventually, however, when it was guided firmly and used after the manner of a lathe tool to take out the irregularities of the surface. In this connection it is a practical tip of some importance in the running of turbo-generators to grind up exciter commutators at working speed, or rather over, as turning-up in a lathe is seldom quite satisfactory. High-speed commutators should be made true under working conditions of speed and support.

The usual power-station plant produces a considerable amount of noise, and therefore visual signals are often employed instead of, or auxiliary to, acoustic ones. The process of calling the Chief by means of a messenger is rather antiquated, and a system of bells or coloured lights in and around the station can, by means of a simple code, be made useful for this service and for others of a like nature. Telephone call-bells are also sometimes reinforced by coloured lights in prominent positions; but the most original use of visual signals with which the writer is acquainted was in connection with a system of circulating water pipes. The layout of the plant and its development had brought the circulating system into a rather complicated state; there were a large number of valves spread over a considerable area, and also alternative suctions. A mistake occurred whereby a condenser suction was opened on to a cooling pond and forgotten, while the delivery returned elsewhere. The pond was quickly drained dry, of course, and the incident resulted in the following convention:—A certain arrangement of valves was adopted as being "normal," and the valve key was then deposited in a rack in the engine room. Any alteration made to the circulating system necessitated the use of the valve key, and the key was allowed to remain on one of the affected valves until a return to "normal" conditions was made. The absence of the weight of the key in its special rack allowed a relay to close a circuit whereby a red light was lit in a prominent position, so that there was no excuse for forgetfulness of the state of the circulating system.

At another station the circulating water was entirely cooled by towers, and the routine procedure was to drain off about a foot depth of water from each tower per day in order to keep down the concentration. Several times the drains have been opened and forgotten, resulting in loss of circulating water and vacuum; and it may be useful to note in this connection that it is not necessary for the water level to reach that of the suction, for vortices may be formed some time before then, and a momentary gulp of air entrained with the water may easily cause a centrifugal pump to drop its suction. In one case in which a loss of circulating water occurred, the generating unit was allowed to continue running exhausting to atmosphere, and as there was no foot valve fitted to the water suction nor steam inlet valve to the condenser, the latter became very hot. When the tower pond had refilled sufficiently, the circulating pump was restarted, with the result that the end doors of the condenser were cracked asunder, and a certain amount of damage was done to the tubes. Afterwards a non-return valve was fitted to the suction, and a town's water supply provided for flooding the condenser water space if necessary. Another case of lost water was due to a violent gale, which, impinging at just the right angle upon towers standing in an exposed spot, literally blew all the water out of them. These towers during one hard winter became so thickly coated with icicles that the air inlet at the bottom was very restricted, and the cooling efficiency fell off to a remarkable extent before the cause was discovered; it took several labourers some hours to clear it and so restore normal low temperatures. Wet air filters as often fitted to turbo-alternators are very liable to become similarly frozen up, and, in fact, in really cold weather it has been found impossible to keep these running, in spite of steam heating coils and a temperature of spray water as high as 55° F. The great danger is that if the eliminator plates become anything approaching solid with ice the suction of the generator rotor will pull the water in the trough through in its liquid state, a proceeding not calculated to increase the insulation resistance of the stator and rotor windings. A certain 3,000 R.P.M., 2,000-volt, 3,000-KW. alternator of Swiss design and construction has been swamped twice in this way with no serious results, and is—like the aunt of our youth—still running.

Frost, too, has been known to interfere with the supply of make-up water for boiler feeding purposes, and this is an important point to watch in severe weather. An undertaking in which there are employed a number of large water-cooled transformers achieves two results by sending its make-up supply first around these cooler coils and around the oil coolers and bearing systems of the large turbo units, before admitting it to the feed tank; it thus conserves heat units usually wasted, and prevents any danger of storage tanks freezing.

A battery of insufficient size in a small station is a delusion and a snare. The temptation to shut down all prime movers at times of light load is irresistible, and probably that proceeding is justifiable in the early days of a station, or where the load is entirely lighting, and therefore easy to foretell; on the other hand, in a lighting station the heavy top loads necessitate heavy feeder fuses or breaker settings, which are out of proportion to the capacity of the battery when it alone is supplying the bars. To prevent a fault interrupting the whole supply under these latter circumstances, it is necessary to substitute small feeder fuses, whenever entirely depending upon the battery. In a very small station this was regularly done, but on one occasion it transpired that during running hours a fault on a large installation had blown its consumers' fuses. The contractor called in was a man of resource, and, failing to find the fault immediately by usual methods, proceeded to blow fuses galore upon it, in the expectation of smelling it out, apparently. However, in the meantime at the station the small feeder fuses were inserted, and the plant shut down upon the battery. The brainy contractor located his fault at length, but the station engineer was horrified to find, upon his return from a plant repair job remote from the switchboard, that the entire town's supply was being maintained through one remaining feeder fuse, and that one was cherry red! The feeders were interconnected by the distributors, of course, but probably one more attempt by that enterprising contractor would have meant total interruption of supply.

With heavy loadings or H.T. A.C., fuses are not now used, of course, for feeders or other purposes; breakers in the case of D.C. and auto oil switches for A.C. having taken their places. Reverse current breakers are very useful in D.C. stations of decent size, for isolating the battery and works power from the main bars. In a large mixed D.C. and A.C. station all auxiliaries were D.C. motor driven, while the battery was of such a size as to be useless for dealing with even one of the outgoing feeders. The battery and works auxiliaries were therefore isolated on to special bars, and arrangements made that certain sets could also be connected, if required. These bars were then coupled to the main bars by means of a reverse current breaker. Normally, the works power flowed through this breaker, and one could even discharge the battery, and so relieve the system of a part of the works demand, if desired; but in the event of a heavy short or a D.C. shut-down, the battery, attempting to supply the main bars, would thereby isolate itself on to the works auxiliaries, and so safeguard their supply and facilitate recovery. Previously there was but little D.C. trouble, and this arrangement was generally considered

somewhat unnecessary, but, within about three weeks of its being fitted, the device saved the station no fewer than five times, and was thenceforth regarded as an excellent idea. So does experience modify conclusions.

A.C. oil switches are usually more or less remote controlled, either electrically or mechanically, and their operating coils and plungers, or relays, are fitted on the switchboard face. Relays ought to be self re-setting, especially for sub-station use, although time-limit fuses are not considered objectionable. A heavy short once brought out all the interconnecting switches between two stations, including several in sub-stations. One station happened to be shut down, and had only banked fires—it was night and the minimum load period. The other replaced one feeder, but the second was faulty. The sound feeder had opened also at a sub-station, and the attendant attempted to replace it without first re-setting the relay. He was unused to the gear, and it took 20 minutes to make him understand by telephone what to do. A demand of about 1,200 KW. had to wait for those 20 minutes.

Isolating links should be near the switches or apparatus isolated, or, at any rate, in the same compartment. If unavoidably in a remote situation, the guard screens of the apparatus and of the isolators should be interlocked. A concrete example of the necessity for this may be cited. A power station's outgoing feeders (E.H.T.) are arranged in duplicate upon the "distribution-house" system, so that one feeder of each pair is taken from one side of the house; in this way, by paralleling the duplicate feeders outside and isolating, quite a considerable number of switches and quantity of bus-bar gear can be made dead for cleaning and repairs. The station transformers were fed from either or both sides of the "house," and could be coupled as required by isolating links in their vicinity and remote from their switches. One side of the "dis-house," as it is usually and colloquially termed, was made dead in order to carry out some alterations, and that particular station switch was opened after paralleling by means of the links. The Resident himself was nearly killed through touching some current transformers which were alive by feeding back from the opposite feeder switch, *viâ* the links. This experience resulted in labels being placed upon the screens of these cubicles, warning operators to be sure of the positions of the station links before commencing work; but this precaution was not sufficient to prevent a repetition of the affair under slightly different circumstances. At a later date the feeders were paralleled outside and one side of the "dis-house" was made dead for some cause, and the charge engineer, being called away from another job for the purpose, proceeded to "flash" the bars before attaching the temporary earth leads which were always in use while work was in progress on any E.H.T. gear. This was done by making fast one end of a stout piece of cable to a good earth, and touching all bars within reach with the other end. To the charge engineer's surprise, there was a heavy flash when this was done to some bare leads, and the opposite feeder switch opened violently; then, and only then, did he remember the isolating links in the basement on the outgoing feeders. These had not been opened, and hence the leads were alive up to the switch terminals, feeding back from the opposite side. It should not have been possible to have opened the screens around the gear until those links had been withdrawn. Luckily, owing to the care taken in "flashing," no one was hurt and no damage was done except for the interruption of supply on those duplicate feeders. Mental aberration of this sort is difficult to provide against, but every effort should be made to have simple interlocks where, as in this case, they are obviously called for. Familiarity, of course, tends to breed carelessness, if not quite contempt, although in the old days of screwed plug-bars the writer has often investigated the temperature of these plugs with the naked hand on a 3,300-volt system, using no other insulation than that provided by standing upon an ordinary wooden chair.

**Electrochemistry in South Africa.**—New works for the production of carbide and electric carbons on a large scale have been established at Germiston, South Africa.

## SOME CONSIDERATIONS ON THE BRITISH ELECTRICAL INDUSTRY AFTER THE WAR.

BY E. S. HODGSON.

Most electrical manufacturing concerns are probably too occupied on war orders at present to give much attention to the development of trade on the conclusion of peace. Yet the question is one that must be tackled vigorously now, or just as soon as the influx of urgent war work diminishes. There is evidence from some sections of the German technical Press that the Germans have this matter well to the fore. They realise that considerable difficulty will be experienced in regaining the fortunate position they held previously, owing to the progress made by British manufacturers and the speeding-up methods which the Americans have adopted as the result of their entry into the world conflict.

The French electrical industry, too, is waking up to the realisation that its manufacturers were left far behind before the war, owing partly to the policy of German penetration, and partly to a certain lack of facilities for higher technical education. That they also will look to the conclusion of peace to give their activities the necessary impetus, there is no doubt. The same, or practically the same, remarks apply to Italy.

It may well be asked whether British electrical manufacturers will be prepared to give serious consideration to the question of combines after the war—a feature to which Germany owes in no small measure the success she attained. At all events, a general selling combine amongst the smaller manufacturers is worth considering. Such combine would be able to employ common representatives in the several European and overseas countries. These representatives should, of course, be men possessing high technical training and undoubted business qualifications. Their business would be to keep well in touch with the authorities in the countries to which they are accredited, report on developments, openings for trade, &c., and to advise promoters of development schemes as to the best plants for their purposes. In this latter connection they could work in consultation with the experts, in order to secure the necessary harmony and close co-operation.

The smaller British concerns—*i.e.*, those who have not travelling representatives in the different countries—would do well to give more attention to the translation of their catalogues into foreign languages, and to the spending of a certain amount on useful propaganda work. This is a point that has, unfortunately, been too much neglected in the past, and the importance of which is hardly yet realised. Some firms, endowed with the spirit of enterprise, are already doing this on a large scale, which will probably justify the trouble and expenditure involved. Greater encouragement might be given to young, technically-trained men to study foreign languages. At present a man who is able to write two languages fluently, in addition to his own, very often finds that the time spent in acquiring that knowledge has been wasted, owing to the insularity of the British manufacturer. How many Englishmen are there to-day, for instance, who could correctly translate a complicated electrical specification into, say, French, Italian, or Spanish? In that direction, too, the Germans were well ahead of us before the war. There were very few firms who were not able to give, promptly, quotations in the leading European languages. They found that it paid to do so. When, say, a Spaniard receives a specification from England written in English and bristling with technical terms, it is not to be wondered at that he should pass it into the waste paper basket, unless, of course, there should be any particular reason why he prefers the British article.

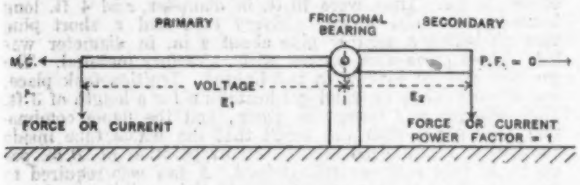
The amount of new electrical machinery required when peace comes will be considerable. Further, Spain and Italy are taking up in earnest the question of developing their hydraulic resources, and here a vast field is open to British enterprise. If all the schemes mature, there is sure to be an increase in electric traction and in the application of electricity to steel production. The South American Republics, again, are as yet practically untapped in regard

to industries in which electric power will be of importance. It will thus be seen how necessary it is that competent men should be sent out to these countries to study conditions on the spot and to report as soon as possible after the declaration of peace, in order that manufacturers may be able to make their preparations in good time. Unless this is done, the Germans will find the field open again for their policy of penetration and monopoly.

## A NOVEL TRANSFORMER ANALOGY.

BY C. W. MARSHALL.

THE principal characteristics of the static transformer can be demonstrated in a very simple way by means of a lever. A weightless lever would have properties corresponding to those of an ideal transformer. The lever arms are the primary and secondary windings, and the fulcrum is the core. The arm-lengths and acting forces are respectively proportional to the voltages and currents. The analogy is easily developed to include features of a commercial transformer, such as magnetising current and transformation losses, the former being represented by a constant bias weight and the latter by pivoting the lever on frictional




bearings. Transformer impedance is demonstrated by varying the stiffness of the lever arms. A flexible lever corresponds to a high-impedance transformer—*i.e.*, one which can pass only a limited current with a given voltage, while a rigid lever represents a low-impedance or high-regulation transformer.

An auto-transformer is distinguished from an ordinary one by having both acting forces on the same side of the fulcrum.

The illustration of more advanced properties, such as the phase displacements in delta-star transformers and the separation of losses, requires somewhat more elaborate models, and the development of these should prove an interesting example for students. An illustrative example is given below :—

| TRANSFORMER. | | LEVER. | |
|---|---|---|---|
| Capacity ... | ... 20 K.V.A. | 200 grammes. | |
| Trans. ratio... | ... 200/100 | Arm ratio | ... 20 cm./10 cm. |
| Applied energy currents ... | ... 100/200 | Forces ... | ... 100/200 gm. |
| Magnetising current | 10 amps. | Bias weight | ... 10 gm. |
| Total losses ... | ... 1 KW. | Adjust bearing friction to suit. Choose lever beam so that it sags to the supporting plane with forces of 100 × 10 and 200 × 10 gm.—*i.e.*, 10 times full load. | |
| Impedance ... | ... 10 % | | |

## GAS FIRING BOILERS.

THE paper read by Mr. T. M. HUNTER on this subject before the INSTITUTION OF ELECTRICAL ENGINEERS was discussed by the MANCHESTER LOCAL SECTION on November 27th.

Mr. T. R. WOLLASTON said the author's 6,000 cu. ft. of gas per ton of coal represented 2,700,000 therms. The same coal could be gasified to give 17,000,000 therms, or six times the amount of electricity, and the by-products, in which coke and coalite would not be included, would probably aggregate equal or greater value. Two or three references in the paper implied that gas-fired boilers should work at 80 per cent. efficiency. The "Bonecourt" worked at over 90 per cent., and he was satisfied that when the problem was properly tackled by skilled boiler makers at least 85 per cent. would be reached. This with a producer efficiency of 70 per cent. (which would also be consistently obtained) would give substantially 60 per cent. all-round efficiency, equal to what some electrical stations were now working at without by-products. He had carried out a series of tests on gas-fired Lancashire boilers with producer gas and with Bunsen type burners, of a type which Mr. Hunter had since improved; the tests lasted for nearly a week, and an average of 17 per cent. $CO_2$ in the gas, never any CO, and never more than 3 per cent. excess O was obtained.

Dr. CRAMP said there was no particular advantage from the point of view of the amount of coal used in firing a boiler by gas. Gas could be used for boiler purposes either in a producer which was entirely apart from the boiler, or in a producer which was part of the boiler. The second proposal Mr. Hunter's paper did not touch upon at all. Many plants ought to be burning their coal more economically, and producing less smoke. For such cases, a producer attached to, or forming part of, the boiler was a method which should not be lost sight of. It was true, in that way one did not get the advantage of by-products, but such producers had been successfully built, and it had been shown that by their means greater economy in the consumption of coal per lb. of steam was obtained. The author said nothing at all about the use of coke for boiler firing; that was surely an alternative. The author pointed out the loss which occurred due to the fact that the whole of the hydrogen in the coal had to be oxidised, producing water which must be kept above the temperature at which it evaporated. If an economiser would stand the condensation of the water on its sides, the temperature of the gases could be reduced, and very much more heat could be got out of the flue gas. The economiser tubes were attacked by the condensed water because the water was not pure, but there were plenty of metals in use in chemical works and other places which would stand strong and weak acids of the nature of the acid which was produced. The author referred to the use of hot fireclay radiators, and that kind of thing; there was, however, a form of radiant energy which was not touched upon—radiant flames. Was it possible to use a flame, not of the Bunsen type but of the radiant type, arranged in the ordinary boiler tube, and thus get the radiancy needed without the use of this radiating fireclay? The question of the use of high-velocity flue gas was not really one of boiler efficiency at all; it was one of evaporation per square foot of surface, and the question whether it was best to use it or not was very largely one of capital cost. With regard to the Le Chatelier formula quoted in the paper, there was some doubt whether it had ever been sufficiently proved. It was a comparatively easy matter to design a Pitot tube which could be used to give accurate results. Mr. Hadley, in his paper on the Rand Mines, described a beautiful instrument which was used in South Africa for measuring compressed air, and the same principle might be adopted in this case. There was, of course, the difficulty that with a Venturi throat, gradual choking-up might result, but with the ordinary form of Pitot tube there was no trouble due to choking of that sort. It was at least as important to measure the air as to measure the gas, and it was the mixture that mattered. Mr. Frith some time ago designed and put into operation in Sheffield, in connection with a gas furnace, an apparatus for measuring both gas and air which had enabled combustion to be carried on in a perfectly regular manner, and in a way which was much more satisfactory than was possible before.

Mr. E. F. WINSTANLEY said the paper contained a list of calorific values of gases, and a statement to the effect that in this country we quoted the number of therms in 1 cu. ft. at 60 deg. F. and 30 in. Hg.; in the table, however, the therms were given for 32 deg. F. and 30 in. Hg. This was an important matter, as anybody using these tables in the English units would find himself about 6 per cent. out in the estimation of the calorific value. There were mistakes in the calculated temperatures, and a big mistake with regard to the loss in efficiency due to the presence of water vapour; the loss to the flues was 14.5 per cent. and 18 per cent. respectively for the dry and moist gases, against the author's figures of 21 and 29.8 per cent. With this correction, there was only a difference of 4.5 per cent. in the output from a given quantity of gas, and not 12 per cent., as stated. Finally, the drop in efficiency was nearer 5 per cent. than 9 per cent., as stated, and the drop in evaporation only 13 per cent., and not 21 per cent.

Mr. S. L. PEARCE said that from the national point of view there could be little doubt that to burn raw coal was quite unsatisfactory, but from the central-station engineer's point of view it was by no means demonstrated up to the present time that by the adoption of gas firing the engineer would be able to produce a unit of energy at a lower cost than at present. The problem might be helped to a solution by the experimental stations which would be established shortly at East Greenwich. He emphasised the fact that the two aims were by no means identical, and that, whilst we might be doing the right thing from the national point of view by the adoption of gas firing, it did not follow that it would enable the central-station engineer to provide energy any cheaper. He had not been able to take advantage of by-product gas, whether from coke ovens or from blast furnaces. Therefore, there were two alternatives—either to put down producer plant in its entirety, or else purchase gas. The author himself did not appear to be over-sanguine in regard to the former, because it had been found that steam could be raised

more cheaply from the coal direct, even after allowing for all the income from the sale of by-products. With regard to the possible utilisation of town's gas, as a basis he assumed that no electrical authority, purchasing town's gas of which the calorific value was about 500, could afford to pay more than about 2½d. per 1,000 cu. ft. Did the author think it at all likely that gas authorities would be in a position to offer gas at that price to the electrical authority? If they could not, he saw very little chance of that co-operation which had been advocated in certain quarters. With regard to producers, he did not want to say too much, because he hoped that before very long, and in a place not many miles from there, it might be possible to install experimental plant working in conjunction with modern marine boilers. As to the suitability of gas for boiler firing, he was not at all impressed by the figures the author gave, in which he talked of its being possible, with suitable combustion arrangements, to obtain evaporations of 5½ lb. per sq. ft. At one of their stations they were putting down boilers of a marine type from which they fully anticipated getting 7½ lb. per sq. ft.

Mr. S. J. Watson said the author dealt with the use of gas for firing boilers, which at once raised the question whether that was the most efficient method of using gas. On the Continent the waste gases from coke ovens or blast furnaces were used direct in large gas engines, and from the point of view of thermal efficiency there was no doubt that better results were obtained in that way than by burning the gas under any form of boiler. By making use of the blast furnace gas, some of the large iron works had been able to reduce the cost of manufacturing iron by something like 4s. or 5s. a ton. The gas engines were mostly of large size, and consequently exceedingly efficient thermal results were obtained. The question of gas firing boilers was very largely one of securing a steady flow of gas; the amount of gas supplied from a blast furnace fluctuated within tremendous limits. The efficiency of a Lancashire boiler would be very low without an economiser, and with considerable moisture in the flue gases the rate of deterioration of the usual type of economiser tubes must be exceedingly high. On the whole, he was inclined to agree with Mr. Pearce that there was little likelihood that gas-producing plants for the firing of boilers were going to be substituted generally for the present method of coal firing. When gas was a by-product instead of one of the principal products, the position was quite different. With regard to the transmission of gas over appreciable distances, the distribution of gas over large areas could not be effected without suffering a severe loss. Mr. Hunter mentioned that the cost of producing one ton of steam was about 1s. 3d. from coke-oven gas. Coke ovens were invariably established at or near collieries, and the cost of 1s. 3d. approximately corresponded to coal at 10s. a ton. He did not imagine that the class of coal which would be used for generating steam at a colliery would have a value of 10s. in normal times; it would probably be more like 4s., or in some cases even less, so that the comparison in this particular instance was not a very happy one.

Mr. Daniel Adamson said that the water-tube boiler had emphasised the necessity for clean water, and the large gas engine the necessity for clean gas, and given clean water and clean fuel the possibilities in the way of improvement in boiler design were almost beyond our dreams. One such improvement would be the adoption of the Lancashire multitubular boiler. He showed a diagram of a boiler four of which were made 30 years ago, and were still at work giving good results. The feature of the design was an enclosed combustion space which avoided loses by air leakage or radiation, combined with a reasonable amount of heating surface, suitably arranged for cleaning. The smaller tubes could be swept through while the boiler was at work, and they were made with ferrules, so that they could be removed for scaling and replaced without damage. The large lower tube was for cleaning the combustion chamber of flue dust without stopping the boiler. If covering the brickwork with tar had been found to be satisfactory in general use, it seemed to be a valuable hint to all users of boilers. The author mentioned several methods of increasing the output of the boiler, but he thought that most of them were illusory compared with the fourth method, especially if clean fuel and water were available. Referring to Dr. Nicolson's experiments, in one portion of the paper the author said the gases were reduced from 1,260 deg. C. to 425 deg. C. in the passage through the flue. That was not quite correct. There was a brick plug in the flue, but the reduction of the temperature in passing that brick plug was from about 1,260 deg. C. to about 700 deg. C., and the 425 deg. C. was the temperature after the gases had passed through what was called the evaporator, which was the next element in the arrangement. When the gases had gone through the economiser, which was the third step, the temperature was brought down to 135 deg. C. The author stated that sufficient heat was transmitted to evaporate 36 lb. of water per sq. ft. of the flue tube per hour; the original report of Mr. Michael Longridge showed that over 40 lb. of steam were evaporated per sq. ft. per hour, and stated that the essence of the system was the saving of heating surface by using high gas velocities. His own view of Dr. Nicolson's experiments was that they put boiler design on a scientific basis.

Ald. Walker said the question had occurred whether there would be any increase of efficiency if the temperature of the primary air were raised, and if so, whether it would not be possible in a central power station to make use, for that purpose, of the heated air from the alternators; the deciding factor would be cost of piping as against increase of efficiency. The ratio of the space required for the producers to the space required for the boilers which they served in many cases would be decisive as to whether or not gas-firing could be installed. As the space required for the producers for very large boilers going up to 100,000 lb. evaporative capacity per hour was greatly in excess of that required for the boilers themselves, it would alter the lay-out of the station and necessitate the covering of much more land. He did not agree with Mr. Watson that if gas was to be used at all, it ought to be used in internal-combustion engines; the overall thermal efficiency of the internal-combustion engine had been equalled by that of the boiler plus turbine in the case of large sets. The high initial cost of gas engines, together with the troubles in running them and other incidentals thereto, were convincing that the future was with large steam turbo-alternator sets. In a central power station, the place where increased efficiency was to be obtained was the boiler house. The series of papers which had been read on steam raising agreed that from 80 per cent. to 85 per cent. efficiency ought to be obtained. If this could be done by producer gas or town's gas, then the question of by-products would assume extreme importance. Before so radical a change as that advocated in the paper was adopted, experimental work on fairly large boilers ought to be undertaken.

Mr. Berry said that a very large experimental "Bonecourt" boiler was put in at the Skinningrove Ironworks. It was fired with gases from coke ovens. The efficiency, on several tests, was maintained at 92 per cent.; 2½ per cent. was deducted for the fan, so that the efficiency was 90 per cent. No other boiler yet designed came near that in heat efficiency. It was so satisfactory that the Skinningrove Co. ordered a second boiler. They were 10 ft. in diameter, and 4 ft. long between the tube plates. Every tube had a short plug through which a narrow pipe about ¾ in. in diameter was led. These pipes were packed with refractory material. The gas was allowed to flow in and lighted. Ignition took place, and the refractory material got heated up for a length of 3 ft. Then the gas was turned on again, and the flame combustion took place, with the result that the whole tube inside became an incandescent mass. An evaporation of 20 lb. per sq. ft. of tube surface was attained. A fan was required to draw gas through this refractory material, and it was found that the fan required about 17 in. water gauge to give satisfactory results. A marine boiler put in at the Birmingham Battery Co. evaporated 11,000 lb. an hour, and the efficiency was just about the same. At the present time boilers were being designed for Government purposes capable of carrying 1,250 lb. pressure. The only thing against the system was the innate conservatism of engineers, who did not like anything new until the man next-door had done the experimental work, and then they were willing to benefit by his experience. The "Bonecourt" boiler was the most scientifically designed boiler known. The temperature was graded, and it was possible to get down the temperature of the gases discharged at the end of the boiler to just a few degrees above the steam temperature.

Mr. Hunter, in reply, said he had not put the results of actual tests in the paper because it was very difficult to get results of tests of gas-fired boilers that were absolutely reliable. Large boilers fired with coke-oven gas, without economisers, gave an efficiency of 85 per cent. They were further tested by an outside engineer some two years or so after they had been set up, and he found that the efficiency then on ordinary working was 83 per cent. The exhaust temperature of the gas was considerably below the steam temperature. From that point of view they compared favourably with the "Bonecourt" boiler. It was quite time that those who were preparing alloys should produce an alloy for the tubes which would enable manufacturers to make a smaller economiser and give a very high additional efficiency with gas firing and clean fuel. Only last week a man who had been ten years in Germany, and had seen some of the best practice there, gave a figure for clean blast-furnace gas working on a boiler of the Lancashire type with economiser; 82 per cent. was the efficiency they obtained. He had known works in this country which approached that figure, but really, before the war the Germans were ahead of us in gas firing. His experience had been mostly with Lancashire boilers in the open air without economisers, and the best efficiency he had found with a Lancashire boiler with economisers was a little over 75 per cent. It might have been considerably increased with a more perfect plant.

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**The Selenium Cell as a Burglar Alarm.**—A sensitive selenium cell has been devised by Dr. O. Hannach, of Berlin, which is able to actuate an alarm signal when illuminated by the flame of a match at a distance of 10 metres; it can easily be concealed in a room, and has the advantage that it can be situated, with its wiring, at a distance from the safe or other valuables that it is intended to protect, in an inaccessible position: as a burglar can hardly work without a light, the idea appears to be a good one. Moreover, the same device would prove effective as a fire alarm. It has the drawback, however, that it can only be used in rooms that are normally in darkness.

## A NEW TYPE OF ENCLOSED MOTOR.

THE advantages of totally-enclosed motors over the open type or semi-enclosed have been obvious to electrical engineers for many years past, especially in cases where the atmosphere is charged with dust or deleterious matter. The chief factor which has prevented the universal adoption of the totally-enclosed motor is the limitation of output due to the increased heating of the motor. The general consensus of opinion is that

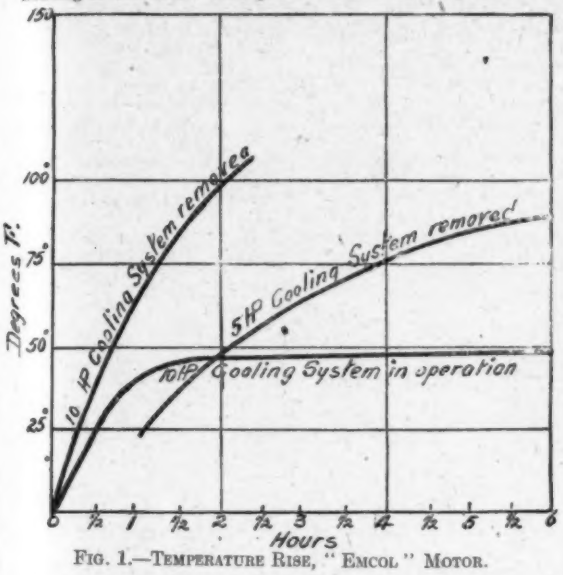



FIG. 1.—TEMPERATURE RISE, "EMCOL" MOTOR.

totally enclosing a motor reduces the permissible H.P. output to 40 per cent. of the permissible output of the same sized motor of the open or protected type. This rule applies to motors up to 40 H.P. For larger motors the output is still more restricted by totally enclosing. The total heat which can be radiated from a motor is proportional to the surface of the motor, and it is obvious that this does not increase in the same ratio as the cubical contents of the motor, whereas the permissible output of an open-type machine is nearly proportional to the total volume. It is found that the restrictions of output by totally enclosing on large motors of 100 H.P. upwards are sufficiently severe to make this type of motor unpractical on account of its unwieldy size, weight, and expense. This, translated into £ s. d., means a greatly increased

FIG. 3.—MOTOR WITH CASING REMOVED, SHOWING AIR CHANNELS AND FAN.

initial cost of installation and upkeep. In addition, the efficiency of the totally enclosed motor is generally lower than that of the open type, especially on light loads, due to the increased size of the motor. Size and weight are also in many cases a deterrent in the use of the totally-enclosed type. This is especially the case in marine installations.

Attempts have been made to overcome these objections, the pipe-ventilated motor being a well-known instance, but the necessary trunking is sufficient to prevent the extensive use of this type of motor. It is necessary in this type of motor to run trunking to a supply of clean air, and as this is often taken from outside, the motors may be adversely affected by moisture being drawn into the motor; this sometimes takes place after motors are shut down. Latterly, other inventions have appeared in which the air is circulated from inside the motor through various systems of cooling

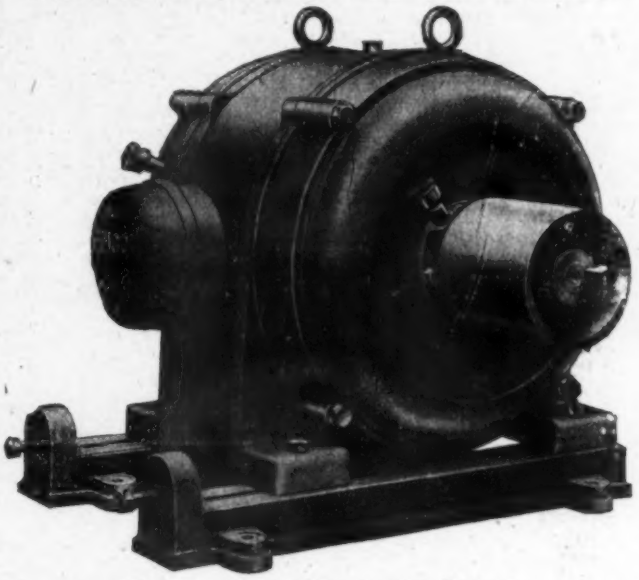


FIG. 2.—"EMCOL" SQUIRREL-CAGE MOTOR.

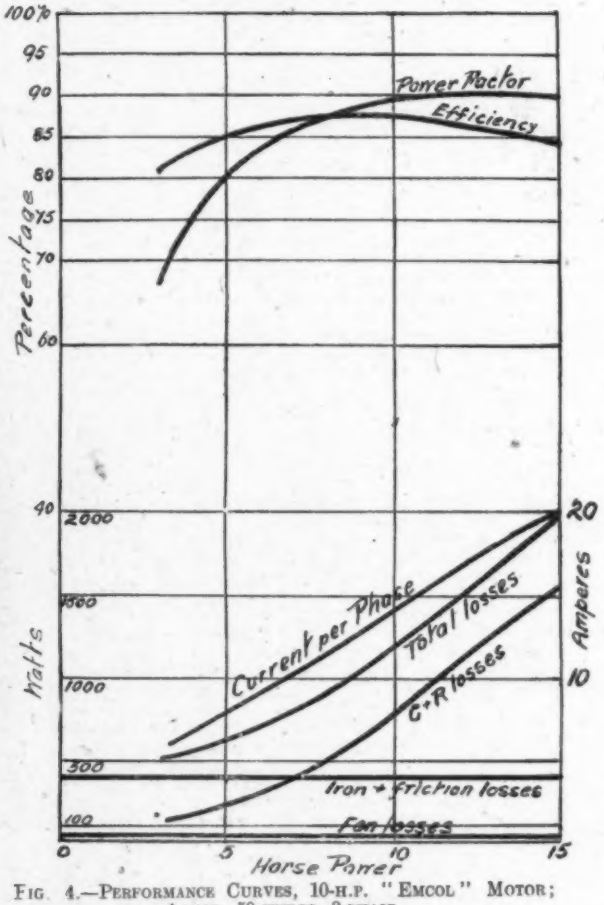



FIG. 4.—PERFORMANCE CURVES, 10-H.P. "EMCOL" MOTOR; 4-POLE, 50-CYCLES, 3-PHASE.

devices and returned to the motor after cooling. These devices have proved partially successful, but they all require an apparatus of considerable bulk external to the motor, needing space which is not always available. In other words, the total bulk of the motor and cooling system is quite equal to, and generally greater than, the space occupied by a standard-type enclosed motor.

Recently Mr. P. A. H. Mossay and Mr. H. C. E. Jacoby

have jointly attacked the problem in a novel and practical manner, and have produced a motor which is manufactured under the trade name "Emcol." It is totally enclosed, and complies in every respect with the definitions of a totally-enclosed motor as defined by the Admiralty standard specification for electric motors for use on H.M. ships, and with the British standardisation rules for electrical machinery.

They claim for their motor that the output for a given temperature rise is even greater than that of an open-type motor of equal bulk and weight. The cost of production is practically the same as for the ordinary standard open-type motor. The makers anticipate that in the near future the great majority of motors will be manufactured on these lines,

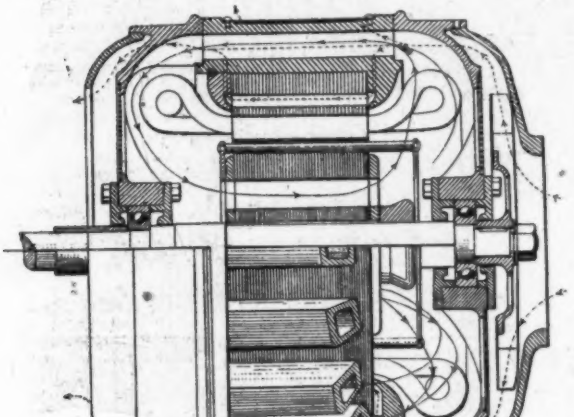


FIG. 5.—DIAGRAM SHOWING AIR CIRCULATION IN MOTOR; DOTTED LINES SHOW EXTERNAL AIR CURRENTS.

it being obvious that if the totally-enclosed motor can be produced for the same price as the open type, this latter will die a natural death.

The chief characteristic of the invention to which we refer is the circulation of the air inside the motor through a cooling system cast integrally with the frame in such a manner that the external dimensions are not appreciably increased. In the case of A.C. motors the cooling chambers are virtually channels cast in the webs which support the laminæ, so that the actual weight of a housing built according to this method is not greater than that of the ordinary standard motor. The cooling channels are cooled by drawing cold air from outside through another series of channels ingeniously arranged so that the cooling air entirely surrounds the hot-air channels. The crux of the invention consists in crossing over the two currents of air so that the cooling air is also in contact with

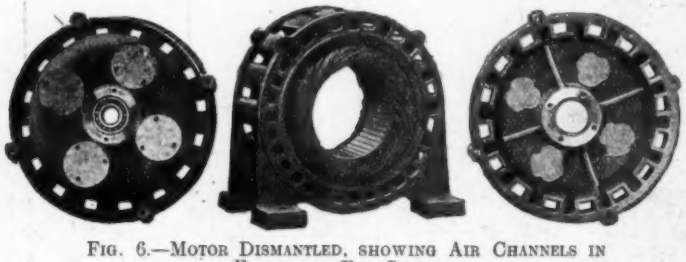


FIG. 6.—MOTOR DISMANTLED, SHOWING AIR CHANNELS IN FRAME AND END SHIELDS.

the outside of the stator laminæ. By this means a very large area of cooling surface is obtained. The cooling air does not enter the motor in any way, but merely blows through the space between the outside periphery of the laminæ and the removable cover.

In D.C. motors the cooling system consists of chambers cast in the magnet ring in such a manner as not to interfere with the distribution of the magnetic flux.

Our views are taken from photographs of a 10-H.P., 3-phase motor, the electrical portion of which was a standard design for 10-H.P., 4-pole open type, 50 period machine, which on a six hours' full-load test, showed a temperature rise of only 54 deg. F. on the winding, the temperature rise of the air inside the motor being 46 deg. F. When overloaded to 14 H.P. the final temperature rise was 65 deg. F. on the winding, and of the air inside, 59 deg. F.

For purposes of comparison, tests were taken on the same motor with the cooling system rendered inoperative, so as to bring the motor under the condition of an ordinary totally-enclosed motor. The results of these tests are shown by the curves.

It should be explained that as the motor would only carry a reduced load under these conditions, the voltage was reduced in proportion to the square roots of the loads, so as to give the best efficiency on the reduced load.

The results may be roughly summarised as follows:—

1. The output of an "Emcol" motor with a given temperature rise is the same as, or better than, the output of a standard open-type motor of the same weight and bulk.

2. The output of the "Emcol" motor is two and a half times larger than the output of a standard totally-enclosed motor of the same weight and dimensions.

We understand that the invention is fully protected by patents, and that the Enclosed Motor Co., Ltd., has been formed to deal with the patents, grant licences, &c. Manufacturers interested should communicate with this company.

## THE LUBRICATION OF AIR COMPRESSORS AND DIESEL ENGINES.

AT the meeting of the DIESEL ENGINE USERS' ASSOCIATION on November 15th lubrication questions were discussed. A note by MR. J. VEITCH WILSON dealt with the subject from the point of view of an oilman with a prolonged experience in the lubrication of internal-combustion engines at home and abroad. He found general agreement that lubricants for Diesel engines should be pure mineral oils. The presence of a liberal supply of oxygen leads to the decomposition of vegetable oils, producing fatty acids and causing the oils to gum; in the power cylinders of well-designed internal-combustion engines free oxygen is practically absent, and in many such engines fatty oils are used with satisfactory results. In the air compressors the conditions are entirely different, and it appeared reasonable to the author that fatty oils or compounds should be excluded from them; nevertheless, he found that in some cases the addition of a small proportion of fatty oil to high-class pure mineral oil put an end to deposits and sticky valves, and gave complete satisfaction.

While in steam engines using steam superheated to 600° or 650° F. a cylinder oil of flash point not lower than those temperatures was used, an oil of 400° F. flash point gave satisfaction in internal-combustion engines, though the temperature of explosion might reach 2,000° or 2,500° F. The explanation of this anomaly appeared to the author to lie in the cooling of the cylinder walls in the latter case by a water jacket, so that their temperature did not exceed 250° F.; there might also be a flameless zone close to the wall, due to the chilling effect of the water jacket, so that the lubricating oil never reached the temperature of decomposition.

MR. G. W. F. HORNER also read a paper, giving particulars of his experience with an installation of Diesel engines and compressors. In 1916 trouble occurred due to a deposit in the I.P. purge pot, which caused excessive wear of the H.P. compressor piston and rings; a brownish substance, looking like rust, dried out in the H.P. stage, and acted on the working parts like emery powder. The oil used and the deposit were examined for the author by a chemist; the former was found to be a pure mineral oil, and the latter was chiefly oxide of iron, which apparently was formed in the purge pots in the presence of air, carbonic acid, and water. To prevent this action, the author had the purge pots painted with a rust and acid-proof paint consisting of 3 lb. English flake iron to 1 lb. of boiled linseed oil; the result was most satisfactory. The author concluded that the formation of the greater portion of the iron oxide took place in the I.P. cylinder and purge pot, and that the protection of the iron and steel surfaces by the paint described was advantageous. He found the internal surfaces of the air receivers rusty, with a deposit similar to that in the I.P. purge pots, and had them also cleaned and painted.

In the discussion, MR. R. L. QUERTIER pointed out that Mr. Horner's plant was close to the sea, where the air contained moisture and salt. He recommended a mineral oil containing a small percentage of animal oil for the compressors, in preference to mineral oil alone.

MR. W. FENNELL considered that if the working conditions of the compressor were good, standard oils of widely different characters could be used with success; the working temperature should be capable of regulation, and a small discharge of air should be allowed from the intermediate purge pot. He doubted whether it could be assumed that the inner skin of the cylinder liner was always at a temperature below the carbonising point of oil.

MR. E. SHACKLETON pointed out the danger of throttling the air suction, which had led to explosions in the intercoolers due to the volatilisation of the lighter fractions of the lubricating oil in the partial vacuum. Owing to the liability to the formation of troublesome deposits in engines burning heavy oils, a thinner lubricating oil should be used in these engines, and water injection was advantageous.

MR. C. O. MILTON pointed out that pure mineral oils could easily be cleaned by heating in contact with boiling water, and used again; compounded oils were not so readily cleaned. Filtering and settling arrangements such as were used in power stations were too slow in view of the large quantities of oil to be dealt with. For air compressors, experience was overwhelmingly in favour of a suitably compounded oil. Water condensed from the air was the cause of the trouble, as it washed the pure oil off the metal surfaces.

MR. NAPIER PRENTICE had had trouble with H.P. piston rings

supported by floating carriers, which was obviated by adopting a tightly fitting sleeve in the carriers.

MR. J. MILTON had experienced trouble due to changing from compounded to pure mineral oil in the air compressors.

MR. J. W. G. BROOKER agreed with Mr. Quertier that moist air laden with salt was favourable to rusting, and tended to the formation of hydrochloric acid.

Mr. P. H. SMITH gave details of practice at Leatherhead, showing the great importance of guarding against the formation of acid in the compressor, which led to burst H.P. copper coils and leaking blast-bottle fittings; by increasing the L.P. pressure and reducing the H.P. maximum temperature, and using a lubricating oil which gave very little acid reaction, the acid in the blast-bottle had been greatly reduced, and the failures of parts minimized.

Commenting on Mr. Horner's communication, MR. J. VEITCH WILSON pointed out that, on changing from one oil to another, deposits might be dissolved and discharged, bringing discredit on the latter oil, which was actually clearing the cylinders of troublesome matter. Replying to the discussion, he pointed out that while mineral oils were not saponifiable, most of them produced troublesome emulsions when mixed with water. For cleaning used oil, two settling tanks were useful, one to receive the oil from the engine while the other was at rest; the oil from the latter should be passed through a sieve, and used for bearings and machinery, but he did not recommend it for cylinders. Compound oils could be cleaned in this way.

MR. HORNER likewise discussed Mr. Wilson's paper, expressing a preference for the use of mineral oil throughout. Replying to the discussion, he emphasised the fact that chemical action was the main cause of the troubles with his engines, which were removed by painting the parts affected.

MR. J. H. GARRATT communicated some notes on his experiences at Singapore, where he traced an excessive formation of acid to the use of foul oil from the crank chamber for lubricating the compressor. To indicate when the H.P. air pipes were corroded to a dangerous extent, the pipes were drilled half way through with a V-shaped drill point, causing a very slight blow when the surface wore down as far as the point of one of the V's. Owing to wear, the blast receivers had to be discarded, and, as they could not be replaced from England, the engines were run without them with successful results.

## CORRESPONDENCE.

*Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### A Proposed Institution of Electrical Station Engineers.

As one of those who attended the meeting at Hammersmith of senior technical officers of electrical power undertakings of Greater London, I had hoped with others that the foundations had at last been laid for the building of an association which would include in its membership every qualified engineer, ranging from chief to junior, engaged in the electric power supply of the United Kingdom.

For some reason or other the movement does not seem to be progressing; whilst one cannot ascertain from whence the opposition is arising—it is apparently there; the enthusiasm and keenness seem only to be shown by the junior staff. Senior and chief officials, as usual, either think it beneath their dignity to take any active part in the movement, or are apathetic; this attitude is most unfortunate, as the time has never been more opportune, or the need greater, for such an association.

As one of the arguments put forward by the disinterested is that no general desire has been expressed for such an association other than by the promoters of the meeting, it would no doubt assist its successful launching if the chief engineers and senior technical assistants in the Provinces, who would support such an association, sent their names to the hon. secretaries of the respective London Associations, the names and addresses of which you, no doubt, would give. I believe that this support has already been given by the staff of provincial stations.

In conclusion, I sincerely hope that the chief engineers of the United Kingdom and their senior officials will not let this great opportunity go by of forming a live Association, the object of which would be solely the protection of interests, and, in a few years' time, find that they are the only ones who have no opportunities of having any redress against grievances which all in the electrical world realise will arise.

Can it be due to a "hidden hand" influence that is interested that such an Association is not formed?

**A. M. P. A.**

### Illuminating Engineering.

I venture to question the wisdom of Mr. A. P. Trotter's remarks in his presidential address to the Illuminating Engineering Society, as reported in your issue of 4th inst.

It seems to my mind to encourage the idea that a qualified illuminating engineer has done his duty to himself in accepting the sense of sight as judgment from one whose mind he has omitted to tutor in its requirements.

Low "diversity factor" and diffusion of sources being the two important conditions for a high standard of illumination, it is well known that the uneducated will more frequently interpret the loss of intrinsic brilliancy as reduction in illumination, and subordinate diversity factor (which is insufficiently preached) to foot-candle intensity. Moreover, whilst the eye can at once distinguish a diffused source from an intensely brilliant one, it is little able of itself, unaided by instrumental measurement, to rate the value of the diversity factor in an installation.

Whilst the eye as an instrument can be relied upon to test whether a preconceived impression has been accurately conveyed to the brain, good illumination is not so much concerned with impressions as with effects upon the muscles and nerves created by those impressions, and these should be the qualities which an engineer elucidates to his clients as being essential to rapid vision and greater physical endurance.

More liberal education from engineers, direct to the public, on the action of light upon the eye, will better assist the illuminating engineering movement and promote increased commerce.

**Sydney O. Cook.**

Glasgow, *January 7th*, 1918.

[In justice to Mr. Trotter, we must point out that our report gave only brief extracts from his long and interesting address.—EDS. ELEC. REV.]

### Meters on a Changed Frequency.

A company is desirous of obtaining a supply of electricity in bulk, and would like the opinion of your readers as to how it will affect the meters:—

1. Present supply is single-phase—220 volts, 40 periods; the new supply will be at 50 periods. What would be the error of the meters if connected to the 50-cycle supply, the voltage being the same?

2. Could the voltage be adjusted to make the meters accurate? If so, what would be the voltage?

**Query.**

### Distinctive Colours for Braided Cables.

With reference to the letter signed "T. D. Spark," in your issue of December 28th, the leading British cable manufacturers make white-braided rubber cables as well as red and black. White-braided cable is made chiefly for the Tropics, and in India practically no red braiding is used, as, for some reason which, I believe, has never been satisfactorily explained, the rubber perishes more quickly with red than with either white or black braiding, in Tropical climates.

**T.**

*January 2nd*, 1918.

### The Production of Ductile Tungsten.

As solicitors for Duram, Ltd., the well-known manufacturers of ductile tungsten for filament lamps and other purposes, our attention has been called to the letter of Mr. John Gray in your issue of December 28th, and to his statement that "British Thomson-Houston Co. were supplying their whole requirements of ductile tungsten for Mazda lamp filaments in 1912 by manufacture at their Rugby works."

Mr. Gray's statement will be received no doubt with amusement by many lamp manufacturers in this country, but there is really no excuse for the inaccuracy of his statement, inasmuch as Mr. Fraser, the secretary of the British Thomson-Houston Co., in an affidavit filed by him in the action brought by that company against Messrs. Duram, Ltd., for infringement of their Patent No. 21,513 of 1906, which action was dismissed by Mr. Justice Astbury and the Court of Appeal, swore that between October 1st, 1912, and September 30th, 1913, the total production of tungsten wire drawn at Rugby, as evidenced by the production sheets, was 5,835,686 *feet*; of which more than two-thirds—viz., 3,824,247 ft.—were drawn from tungsten rods and coarse wire imported from the General Electric Co. of America.

The total production of finished wire manufactured and drawn in its entirety at Rugby was only 2,011,839 ft., and the value of much of that for lamp-making purposes can be appreciated, since the production sheets show that quantities of this were in lengths of less than 100 ft.

Allowing for wastage only 20 per cent., which would be very generous at that date, and allowing 3 ft. to a lamp, the British Thomson-Houston Co. only made wire in its entirety for 536,490 Mazda lamps during the period mentioned. It will, in addition, be noted that this period includes nine months of 1913, whereas Mr. Gray speaks of 1912, when his company could hardly have been more successful.

Having had his attention called to the matter, Mr. Gray would not wish us to omit to notice that the secretary also admitted the importation of lamps from America during the same period.

Having proved the inaccuracy of Mr. Gray's statement, we may be permitted to add that our clients, Messrs. Duram, Ltd., are, and have for some time past been, manufacturing millions of *metres* of drawn tungsten wire at Hanwell, and are far more competent to supply the whole of the requirements of the United Kingdom than the British Thomson-Houston Co.

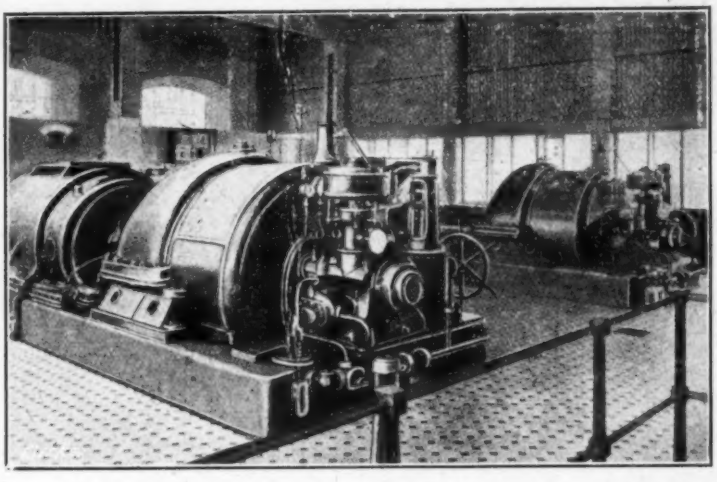
**Speechly, Mumford & Craig.**

London, W.C., *January 8th*, 1918.

## ELECTRICALLY-DRIVEN CEMENT WORKS.

IN a paper read before the INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND, by Mr. B. J. Day, the works of the Aberthaw and Bristol Channel Portland Cement Co. were described in some detail, the latter including particulars of the electrical equipment—the works being electrically driven throughout from a private power station.

The processes employed in cement manufacture have been described several times in our pages; that employed at Aberthaw is the wet process. The works have been erected on the limestone beds, and the quarry has been opened at the nearest point, allowing space for a six-kiln plant, capable of turning out 360,000 tons of cement annually, though the first installation consisted of a two-kiln plant to deal with 120,000 tons of cement per year.



TURBINE PLANT AT ABERTHAW CEMENT WORKS.

The materials are quarried by a steam navvy and broken up in two jaw crushers, being then delivered to wet mills, consisting of four-ball and four-tube mills.

At Aberthaw four of the largest size mills have been installed, each pair of ball and tube mills being driven by a separate 350-H.P. motor. The latter are installed in a motor house distinct from the mill house, and drive extensions of the mill shafts. The slurry obtained from the mills is delivered to two storage tanks of a sufficient capacity to manufacture 600 tons of cement, in which the mixture is adjusted to the correct proportions. The slurry is subsequently pumped into two revolving kilns, each 200 ft. long, 10 ft. diameter in the burning zone and 9 ft. diameter in the parallel section. Each kiln is gear driven by an electric motor, at a point about half way in its length, the gearing giving a maximum speed of one revolution in 55 seconds.

The clinker delivered from the kilns, after being cooled, is passed through grinding mills consisting of preliminary ball-tube mills and finishing tube mills, and the finished product is conveyed to a 10,000-ton silo consisting of 20 500-ton bins.

The electrical arrangement of the clinker grinding house resembles that adopted for the wet mill. One of the most important items is the plant for the preparation of pulverised coal for the kilns.

Each ton of clinker requires about 5 cwt. of coal; the latter is stored as received from the colliery in bunkers, which discharge automatically on to conveying plant delivering to crushers, which reduce all large lumps.

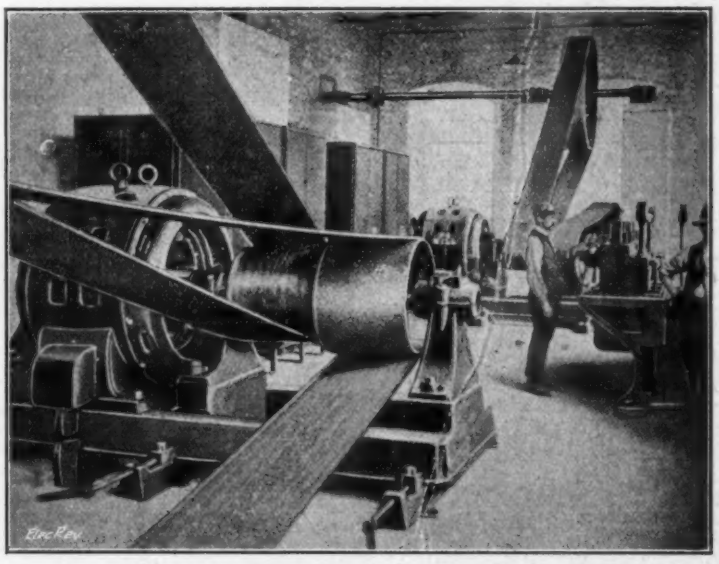
The crushed coal is passed through a revolving dryer, and subsequently pulverised in ball and tube mills, so that the residue does not exceed 5 per cent. on a 100² mesh sieve. Most cement works rely upon one or more main low-speed engines for their supply of power, supplemented in some cases by one or more smaller electric generating sets for small machines or outlying machines. The main engine drives one or more long countershafts by ropes or belts, or both. The effect of this is to cramp the whole of the works, and necessitates laying down various machines where they can be most easily driven. The result is numberless small cross-belts and countershafts entailing heavy upkeep costs, besides undue waste of power. Compared to many modern cement works, the simplicity of the arrangements at Aberthaw appeals to the works manager, apart from the economy involved. After having closely studied modern methods of manufacture in this country and on the Continent, Mr. Day, although it was a novel idea in this country, decided to drive the whole of the plant throughout electrically. By adopting this system an extremely simple layout was obtained, and one that can be extended very easily should trade warrant it.

Owing to the excellent supply of water, it was decided to lay down two turbo-generators, each having a capacity of 1,500 KW. The steam-raising plant consists of five 30-ft. Lancashire boilers, each fed by elevators which deliver coal from the storage bunkers to the hoppers on the front of the boiler, from whence it passes to Bennis stokers. The boilers generate steam at 180 lb. pressure, the steam being superheated to about 600° F. A Green economiser is installed, and the draught is provided by an induced draught fan and compressed air on the Bennis system. A Sulzer turbine-driven boiler feed-pump exhausts into a condenser fitted in the hot-well tank; with this arrangement the whole of the latent heat is recovered, and the thermal efficiency is a maximum.

The generating plant consists of two 1,500-KW. Escher-Wyss turbines driving Brown-Boveri and Siemens generators respectively, with direct-coupled exciters, and supplies three-phase current at 50 cycles and 3,000 volts. A wet air-filter is provided for the alternators, as trouble is experienced with cloth filters in cement works owing to the cement dust adhering to the fine hairs on the cloth. The condensers are of the counter-current surface type, with rotary-type pumps. Each set has its own condensate pump and dry-air pump, electrically driven. Over the hot-well is fitted a notch tank connected to a Lea recorder.

The condenser circulating pumps are installed in a small pump house close to the river, each driven by a 40-H.P. motor. The pumps do not require this power except at starting, as a siphon pipe has been installed connecting up the outlet of the condensers to a water seal at the same level as the pump house; so that really the pumps have to deal with the friction in the condensers and piping, plus a short suction head. In the pump house also are installed two Rees-Roturbo pumps, each motor-driven, for the general water supply of the works. A large quantity of water is used, not only in the raw grinding mills themselves, but also all mill and kiln bearings are water-cooled, thus economising lubricants.

All motors above 50 H.P. are supplied direct at 3,000 volts pressure; all smaller motors and lighting at 220 volts. The main switchboard, by the B.T.H. Co., consists of 13 panels, controlling both generators, and two 400-KW. oil-cooled transformers supplied by the British Electric Transformer Co. From this board are also run separate circuits to the crusher-house, raw-mill, clinker-mill, and coal-mill; as it is essential that there shall be no possible interference with the running of the kilns, each is separately supplied from the main board direct. Distributing switchboards are fitted in the raw-mill, clinker-mill, and coal-mill; each mill unit is separately controlled, and can be stopped immediately by pressing a button on the feed platform. All the above switchgear is of the totally enclosed dust-proof oil-immersed type.



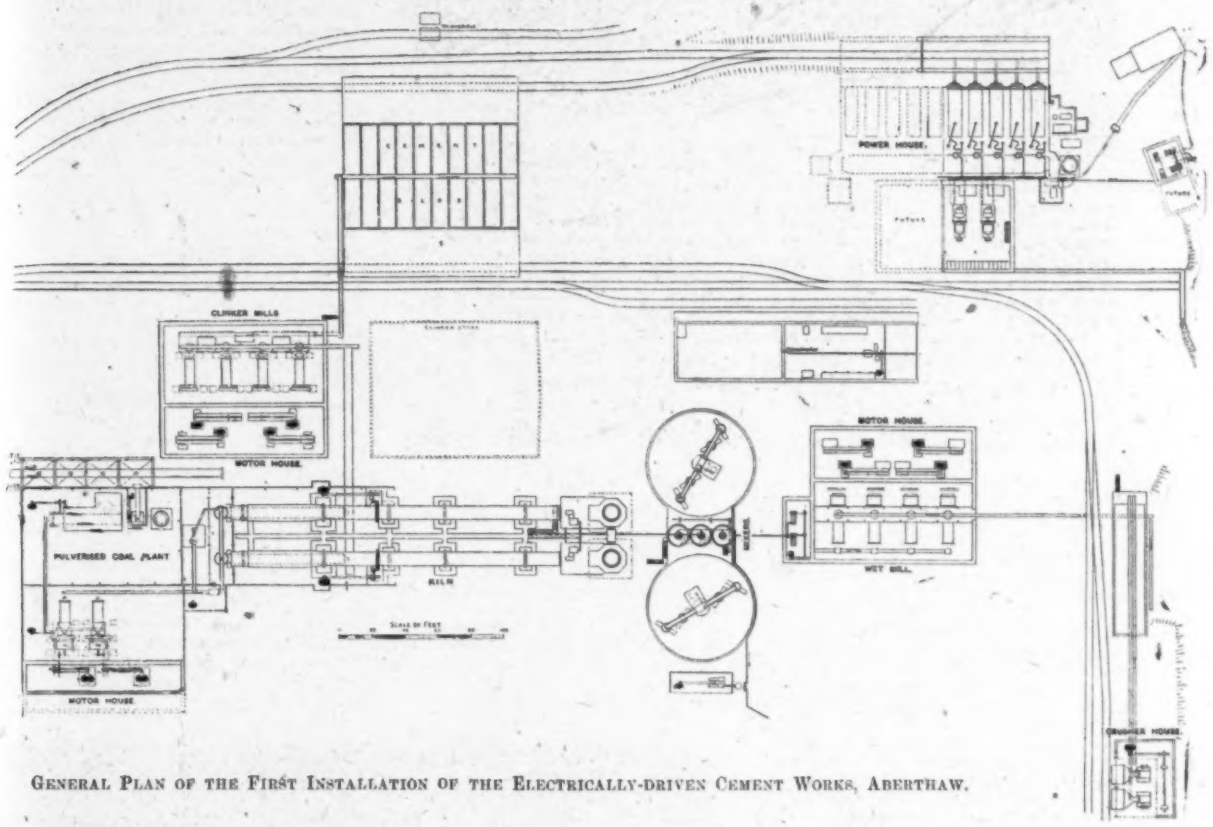
RAW-MILL MOTOR HOUSE, ABERTHAW; A SIMILAR ARRANGEMENT IS ADOPTED FOR THE CLINKER MILL.

The low-tension board consists of 10 panels with 12 power circuits and 9 lighting circuits.

As is well known, the dust-laden air in a cement factory is full of highly hygroscopic particles of dust, which are injurious to

insulation, and special precautions must be observed to prevent dust reaching the windings. For all large motors above 100 H.P., special motor rooms have been provided, in which the motors are installed, which can be made practically dust-proof. Each motor drives a ball and tube-mill unit through belts attached to specially extended countershafts. All motors over 50 H.P. and up to 100 H.P. operate at 3,000 volts pressure, and are of the pipe-ventilated type; motors over 5 B.H.P., and up to 50 B.H.P., operate at 220 volts pressure, and are also of the pipe-ventilated type. All 5-H.P. motors and smaller are of the totally enclosed type; with this arrangement it is obvious that the air passing to the motor windings can, whenever necessary, be completely controlled and filtered.

The switchgear throughout is of the dust-proof type. The low-tension distributing boards consist of cast-iron boxes mounted on brickwork bases and are dust-proof. All the cables are of the B.I. & H. three-core paper-lead type laid in brick ducts with cement slabs over, one main cable trench being carried through the works.




General Plan of the First Installation of the Electrically-driven Cement Works, Aberthaw.

A total of 42 motors of 731 H.P. is included in the installation, including eight 350-H.P. and two 100-H.P. machines. These motors are of Swedish G.E., B.T.H., and Siemens make, and Mr. Day mentions, as a feature of the installation, that accurate figures have been obtained with the electric drives of the power required per ton of output with varying degrees of fineness from the different machines. [We understand that the plant has been extended recently.—Eds. Elec. Rev.]

## WAR ITEMS.

**Raw Asbestos Order.**—Under the Defence of the Realm Act it is ordered that no person or company shall sell, supply, or deliver any raw asbestos, including asbestos crude and asbestos mine fibres, or purchase or negotiate or take delivery of any raw asbestos, &c., except under licence or permit issued by the Admiralty. Those engaged in the manufacture or sale of asbestos or asbestos products will be required to make returns.

**Exports to China.**—The "London Gazette" for January 8th contains a list of further persons and bodies in China to whom exports may be consigned.

**The Fire at Krupps.**—The Dutch newspaper "Handelsblad," in reference to the fire at Krupp's Essen works last month, says damage estimated at some millions of marks at least was done and over 200 electric motors were made totally unusable.—*Times.*

**Trading with the Enemy.**—The "London Gazette" for January 4th contains further lists of persons and bodies in the following countries with whom trading is prohibited:—Argentina, Bolivia, Brazil, Central America, Chile, Cuba, Greece, Netherlands, Netherland East Indies, Norway, Peru, Spain, and Sweden.

**Tank Week at Birmingham.**—The staff and employés of the Birmingham electric supply department showed very practical interest in "Tank Week," by which well over six millions were obtained, thus establishing a record for this country. The electric supply employés headed the list of the Corporation departments with a contribution of £10,000, the gas department following with £7,405. The Electric and Ordnance Accessories Co.'s employés invested £52,653.

A feature of Birmingham "Tank Bank" week was the subscriptions from the working classes, who took full advantage of the various schemes different firms put into operation to enable their employés to participate. Staff and employés of Messrs. J. H. Tucker & Co. were able to purchase War Saving Certificates, repaying the firm for them by easy weekly instalments of any amount, as low as 3d. per week per certificate, with all the advantages as regards interest as though they had paid immediately the full purchase price. In the event of an employé leaving before the whole of the instalments are paid off (1) the employé can pay off the balance, or (2) the firm will repay in full the instalments already paid and retain the certificates. The result was application for the handsome total of 4,500 certificates, in addition to the firm's own contribution of £20,000.

**Exemption Applications.**—An electrician (40, B 2), who appealed at Brighton, was given two months' exemption.

At Sheffield, an appeal was made by G. West (37, C 3), electrician, and he was given exemption until March 31st.

## BUSINESS NOTES.

**Italy.**—There has been formed, at Bovisa, the Società Anonima Cerettise Tanfani, with a capital of 5,000,000 lire, its objects being the construction of rope railways, aerial lines, telegraph lines, cranes, &c.

Società Anonima Italiana Carboni Elettrici is the style of a company, with a capital of 4,000,000 lire, established at Rome, for the manufacture of electrodes for electric furnaces.

With the title of Società per lo Sviluppo della Cianamide e di altri Prodotti Chimici, a company has been formed at Rome, under the auspices of the Banca Italiana di Sconto, with a capital of 12,500,000 lire.

**Suction Gas Plants for Sale.**—The Ton Pentre (Rhondda Valley) Co-operative Society and the Ynyshir (Glam.) Workmen's Hall and Institute have each a complete suction gas plant for disposal For particulars see our advertisement pages to-day.

**The New Board of Trade Journal.**—The first issue of the *Board of Trade Journal and Commercial Gazette* (sixpence weekly) in its altered form appeared on January 3rd. It contains a "foreword" by the President of the Board of Trade and in a series of special articles there is given a good deal of informative matter such as the industrial and trading community will doubtless welcome. In our opinion it gives promise of being of considerable service in assisting traders and in encouraging trade development. The article on "After-War Trade: Reports of Departmental Committees" brings together the objects, personnel and work of these committees in a concise form, though still leaving our thirst for information respecting the detailed doings and conclusions of some of these committees unsatisfied for the present. In due course, however, even this want is to be supplied to some extent in a series of special articles which we naturally await with interest. A first article on "The Patents and Designs Bill," which came before the Commons in November last, describes the provisions and purpose of the measure, and it is to be followed by another explaining some of the clauses not covered in this opening contribution. The article on "Commercial Information: Methods of Distribution" ought to be carefully read by everybody in the electrical industry so that they may know exactly what the new Department of Overseas Trade (Development and Intelligence) is either already doing or is prepared to do for them in support of their own export trade efforts. The other contents of the *Journal* include a large collection of trade news, information collected from different parts of the world, Government notices affecting trade, and Customs' Regulations and Tariff changes such as readers of the old journal had long been accustomed to. We prefer the new and less monotonous looking manner in which the information is served up. We wish those who are responsible for the conduct of the publication every success in their endeavours to make the *Journal* an official record of increasing value. Under war-time conditions no journal can do all that it would. Paper restrictions necessarily hamper us all, a most regrettable circumstance seeing the vital necessity for having all our trade armour and weapons ready for the days that are to come.

**The British Engineers' Association.** — An official Directory of Members (1917), has been issued by the British Engineers' Association, of 32, Victoria Street, Westminster, S.W. 1, price 5s. It is a volume of over 400 pages, in a stiff white cover, with patriotic design in suitable colouring. The letterpress is printed in three languages—English, French and Russian. The fact that membership is a guarantee of British origin of manufactures is the first point put forward, and an invitation is given to engineering visitors from the Colonies and Allied or neutral countries to call at the offices in London. The book is divided into several sections, which are led up to by an introductory statement concerning the Association and its work. Part I consists of a Directory of Members and their addresses, also telegraphic addresses and codes. Part II classifies their manufactures according to the British alphabet, and Part III according to the French and Russian alphabets. The remainder is devoted to a very large collection of illustrated announcements or advertisements by certain B.E.A. Members. The Association invites applications for copies of the Directory from consulting and managing engineers, municipal engineers, merchants, railways and tramways, and other important users of engineering plant and materials, both at home and overseas.

**Dissolutions and Liquidations.**—EDISON MANUFACTURING CO., LTD.—Meeting February 6th, at 164, Wardour Street, London, W. 1, to hear an account of the winding up from the Liquidator, Mr. A. F. Wagner.

H. R. LATHAM & Co., electrical and general engineers, 16-18, Vauxhall Road, Liverpool.—Messrs. H. R. Latham & F. Wilde have dissolved partnership as from June 25th, 1917. Debts will be attended to by Mr. H. R. Latham, who will continue as general engineer at the above address. Mr. Wilde will carry on business as the Liverpool Electrical Engineering Co., at 20, Vauxhall Road, Liverpool.

ADAMS, BEARDSALL & Co., electrical fittings manufacturers, East Stanley Street, Salford, and Manchester.—Messrs. F. W. Adams & W. E. Beardsall have dissolved partnership. Mr. Adams attends to debts, &c.

CARSON & EVANS, 121A, Bunhill Row, London, E.C. 1.—Messrs. F. M. Carson & T. Wozencroft Evans have dissolved partnership. Mr. Carson will continue the business as F. M. Carson, and will attend to debts.

W. C. TACKLEY & Co., LTD.—Meeting called for February 2nd at the High Street, Croydon, to hear an account of the winding up from the Liquidator.

DRUM ENGINEERING Co., Bradford, engineers and pump manufacturers.—Messrs. W. I. & C. E. Johnson have dissolved partnership. Mr. C. E. Johnson will attend to debts and continue the business.

**Electrical Firms and the Royal Arms.**—The following electrical firms are included in the list just published in the *London Gazette* of concerns having authority to use the Royal Arms by reason of their holding warrants of appointment to H.M. the King:—Edison Swan Electric Co., Ltd., the Hart Accumulator Co., Ltd., Messrs. A. P. Lundberg & Sons, Messrs. Burt, Escaré & Denelle, Ltd. (electric fittings and bronze manufacturers), and Messrs. Perry & Co., Ltd. Messrs. Tusker, Sons and Co., telephonic and electrical engineers, Sheffield, have also the right to use the Arms under a warrant of appointment from the late Queen Victoria.

**Book Notices.**—The Christmas number of the *M. and C. Apprentices' Magazine* is quite a thick volume, and contains a wide variety of reading matter. A portrait of Mr. Henry A. Mavor is accompanied by an extremely interesting and well-written biographical sketch of this versatile and talented pioneer in electricity supply and the electric propulsion of ships. Mr. W. W. Lackie, an old apprentice of the firm, contributes an article containing excellent advice to apprentices; as for the rest of the contents, including the numerous illustrations, we can only say that there is something for everybody, and the whole deserves the highest commendation.

A new publication of the U.S. Bureau of Standards (Circular No. 68), entitled "Public Utility Service Standards of Quality and Safety," contains a brief outline of the public service activities of the Bureau, together with lists of the publications bearing on the various subjects which have been issued by the Bureau. The sub-headings giving the public service activities are:—Standards for Electric Service, Standards for Gas Service, Standard Methods of Gas Testing, National Electric Safety Code, Electrolysis Mitigation, Further Activities. Those interested may obtain a copy by addressing a request to the Bureau, at Washington, U.S.A.

*The Electrical Engineer's Diary*, 1918 (S. Davis & Co. Price 6s.), which is now in its tenth year, contains a large amount of new information, and is really quite an encyclopædia of engineering, containing sections on the generation of electricity, its uses for motive power, lighting, cooking, and heating, and the installation of telephones and bells, as well as official rules and regulations, a useful list of London streets in which mains are laid, and a table of electricity supply authorities in the United Kingdom. The range covered by its contents is extraordinarily wide, and it is well printed on good paper, the sections being distinguished by different colours. The diary portion contains eight days to an opening, affording ample room for notes, and sectional ruled paper is used for this part. An edition bound in limp covers, without the memorandum pages and blotting pad, is also issued.

**Calendars and Diaries.**—MESSRS. THERMIT, LTD., of 675, Commercial Road, Limehouse, London, E. 14, have sent us, as usual, one of their pocket calendars and note-books for the year. "Thermit" welding information is given in the opening pages.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., 38 and 39, Upper Thames Street, E.C. 4, have prepared for their friends, and for any reader who writes in, sending his trade card, or applies to one of the company's branch organisations, the Wotan pencil economiser; a useful pocket novelty closely resembling a fountain pen in appearance, and enabling any pencil to be used up to the last ½ in. It is provided with a split-tapered bush to accommodate pencils of varying thicknesses, &c. This little article reminds the writer to "Use Wotan Lamps for Economy."

MESSRS. ALFRED HERBERT, LTD., of Coventry, have issued their 1918 calendar in the same size but in slightly different style from that of the art paper calendars of recent years. The covering page gives a view of Ford's Hospital at Coventry, and the rest consists of boldly-printed monthly date sheets, the upper half of which is occupied by a view of the firm's works or the equipment therein.

**Catalogues.**—BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Twelve-page descriptive list (No. 4,221), describing their automatic circuit-breakers for A.C. and D.C. circuits. The list is fully illustrated, and, as usual, contains tabulated dimensions, dimension drawings, and shipping specifications.

MESSRS. C. A. VANDERVELL & Co., LTD., Acton, W. 3.—January moon chart for postcard service.

**Commercial Libraries.**—At a meeting of the Birmingham City Council, on Tuesday, it was decided to establish a Commercial Library, and to proceed with the necessary work at an estimated cost of £1,500. The library will contain British, Colonial, and foreign directories; telegraph codes; maps; annuals relating to various countries; Consular reports; and books on commercial law, accountancy, business methods, and organisation.

**British Industries Fair, 1918.**—As it is possible that the new accommodation for the British Industries Fair (Glasgow), 1918, may not be entirely completed by February 25th, and as it is of great importance that the British Industries Fairs in London and Glasgow should be held simultaneously, the Board of Trade have decided to postpone the opening of both Fairs for two weeks. Accordingly the period for which the British Industries Fairs in London and Glasgow will be open will be March 11th to March 22nd.

**Bankruptcy.**—W. J. FAHN, consulting engineer, Maida Vale.—First and final dividend, 1s. 11½d. in the £.

**Trade Announcements.** — One of the latest business amalgamations consequent upon the war is the incorporation of MESSRS. WHITTAKER & Co., of White Hart Street, Paternoster Square, E.C., with SIR ISAAC PITMAN & SONS, LTD. Messrs. Whittaker, of whose firm Mr. A. J. Rayment is the sole surviving partner, the other having given his life for his country, have long been known as publishers of scientific and technical books, and their catalogue contains many important electrical works. Messrs. Pitman will enjoy the benefit of Mr. Rayment's experience and his knowledge of what is required by scientific and technical students, as he intends to direct from their offices the new department thus added to their undertakings.

The name of the Oliver Arc Lamp, Ltd., has been changed to the "OLIVER-PELL" ELECTRIC AND MANUFACTURING CO., LTD.

# LIGHTING AND POWER NOTES.

**Aberystwyth.**—E.L. SCHEME.—Mr. Carrington, of the Rheidol Lead Mines, has submitted an electric light scheme to the T.C. It is proposed to erect a power station in the Rheidol Valley close to the mines, and supply current to the town. The T.C. has appointed a Committee to visit the site and report on the scheme.

**Bedford.**—The T.C. has disposed of the old plant in No. 1 engine room at the electricity works to Mr. P. Stanton for £300.

**Belfast.**—The resolution of the Corporation authorising the Tramways and Electricity Committee to take the necessary steps to give effect to the recommendations of Sir John Snell, including the application for the sanction of the L.G.B. to the provision of £60,000 for equipment for the electricity station, was the subject of severe strictures at the meeting on the 2nd inst. Councillor Alexander attacked the proposal, objecting to the expenditure of so large a sum of money under the present management. Alderman Tyrrell said the expenditure arose out of the breakdown of No. 10 turbo-generator. Arrangements were nearly complete for the installation of a new 5,000-KW. set.

At the local Munitions Tribunal recently, the Corporation proceeded against 97 men of the electricity department for having taken part in a strike in connection with a difference as to the rate of wages, in contravention of the Munitions Act. It was reported to the Court that the men had returned to work, and leave was asked to withdraw the summons, which was granted.

**Birmingham.**—The City Council has adopted a report of the Labour Committee granting to all employés of the Corporation a further war advance in wages. A proposal was approved altering the general instructions of the Council, and appointing a Special Committee for dealing with salaries, so as to avoid the necessity of public discussions on the merits of the principal officials.

**Blackburn.**—PROPOSED NEW STATION.—On the invitation of the Electricity Committee, the chairman and vice-chairman of the Gas Committee have joined a special Sub-Committee of the former body which is considering the question of the necessity of proceeding with the work of construction of a new generating station.

**Blackpool.**—An additional supply of electricity for light and power is required at the King's Lancashire Military Convalescent Hospital, Squire's Gate, and the Electricity Committee has agreed to lay the new main required on condition that the military authorities will pay one-third of the cost.

**Blackrock.**—PROV. ORDER.—The B. of T. has extended the Electric Lighting Order for a further period of one year.

**Bradford.**—The Electricity Committee recommends that a new generating station be erected on the Esholt estate—a large Corporation estate used in part by the sewage undertaking; the city electrical engineer is to prepare plans and estimates, with a view to application to such Government Departments as may be concerned for sanction to carry out the scheme.

At a mass meeting on Sunday night last, all classes of Corporation employés rejected the proposed Corporation increase in the war bonus. The matter affects between 4,000 and 5,000 workers, and they now ask that the matter shall be referred to arbitration.

**Clayton.**—PROV. ORDER.—The District Council is still discussing the future of the electricity supply; at a meeting last week, the Council decided to be tied down to nobody, though it is felt to be quite likely that Clayton will be incorporated in Bradford after the war, and the Council is to apply to the L.G.B. for a prov. order to supply electricity on its own account.

**Clyde District.**—The Clyde Valley Electrical Power Co. has greatly increased its output during 1917, and the total connections to the company's system are now equivalent to 110,000 H.P. Another 7,000-H.P. turbo-generator has been added at the Clyde Mill station, with considerable additions to the steam-raising plant at Yoker, and it is anticipated that there will be in operation at the latter station by next autumn a 20,000-H.P. turbo-alternator. The average price of power for the past year was '68d. per unit.

**Continental.**—RUSSIA.—A recent issue of the *Novoye Vremya* states that for want of fuel the electric lighting of Petrograd has been reduced. The Electric Equipment Co. (formerly "Helios") will deliver current to subscribers between 6 a.m. and 12 midnight only. The Belgian Co. is now delivering current during the night only for street lighting, military headquarters, Council of Workmen's and Soldiers' Delegates, and some town hospitals. It will not supply current to subscribers before 3 p.m. until it receives fresh supplies of fuel. The 1886 company has also reduced its output.

SPAIN.—The *Times* states that Madrid is now without light owing to want of coal.

**Doncaster.**—The R.D.C., last week, decided to oppose the new Bill of the Yorkshire Electric Power Co.

**Dublin.**—The Electricity Committee has recommended a further increase in price for lighting of ½d. per unit, and of ¼d. per unit for power. The Committee pointed out that the deficit last year was £1,575, but that there had been a net loss of income on premises destroyed during the rebellion of £6,018. The exceptional expenditure due to the war included £10,085 extra for coal. Increased charges brought in an extra income of £13,293, leaving a balance of £12,886, which, with the exception of £1,575 deficit, was made up by improved business. The Committee has made certain representations to the Council in regard to the Council's attitude to the electricity undertaking, and asks that the Council will confer on it emergency powers to enable it to take the necessary steps for the maintenance of supply during the war, otherwise it declines responsibility for the conduct of the undertaking.

**Dulverton.**—WORKHOUSE LIGHTING.—The B. of G. has decided to have the electric light installed at the workhouse, at a cost of £35 for 25 lights.

**Elland.**—PROPOSED LOAN.—The Council has instructed the clerk to take the necessary measures with a view to borrowing £2,000 for electricity extensions, and has approved an advance in wages of all regular Council workmen to 15s. above pre-war rates.

**Gillingham (Kent).**—PRICE INCREASE.—The T.C. has decided to further advance the price of current for lighting by 10 per cent., a total increase since the war began of 50 per cent., and for all other purposes by 20 per cent., a total increase of 60 per cent., as from the meter readings taken at the end of December last.

**Halifax.**—PRICE INCREASE.—At the T.C. meeting, the Electricity Committee proposed an increase in charges for lighting and heating of 12½ per cent. and of 20 per cent. to power consumers not under agreement. In moving that the recommendation be referred back, Councillor Swaine urged that the cost was little more than 1d. per unit, but the lighting consumers were charged 4d., and instead of rushing up the price, it would be better to give facilities for introducing electricity into as many homes as possible. If there was any increase, it should be for power only. Alderman Spencer, replying to a discussion, said the increase was modest in proportion to the increased costs. The lighting consumption was only 1,400,000 units out of a total of 16,704,060. The amendment was defeated and the recommendation approved.

**Lancashire Electricity Suppliers and Coal.**—It was reported on Tuesday in Manchester that many municipal Electricity Committees in East, Central, and South-East Lancashire intend backing up the Salford Town Council in its protest to the Coal Controller against the last increase of 2s. 6d. per ton in coal prices. The imposition is deeply resented in Lancashire municipal and industrial circles.

**Leeds.**—EXTENSIONS.—At a meeting of the City Council, last week, it was announced that, as a result of the Ministry of Munitions, sanctioning the purchase of a 6,000-KW. turbo-alternator, but declining sanction to the big extension scheme, the work which may proceed includes the removal of two 15-year old 1,400-KW. machines and the substitution of the one sanctioned. The work will cost about £35,000, and it is hoped it will be completed in time for next winter's demand.

**London.**—HACKNEY.—The Electricity Committee has accepted the tender of Messrs. C. A. Parsons & Co., Ltd., and has requested the Finance Committee to take the necessary steps to procure a loan of £40,000 for the purchase of the machinery, &c., as follows:—7,500 K.V.A. turbo-alternator and auxiliary plant, £32,395; foundations and platforms, £1,500; pipework and cablework, £1,500; switchgear, £1,102; contingencies, £3,503.

**Manchester.**—At the last meeting of the Finance Committee, the city treasurer was authorised to borrow £20,000, repayable within 25 years, for purposes of the electricity undertaking.

The Electricity Committee has recommended the Council to grant to the adult male skilled and unskilled employés in the electricity department a further bonus of 5s. per week recently awarded by the Committee on Production, and recommended that the question of whether or not the semi-skilled and unskilled employés in the department are entitled to receive the bonus of 12½ per cent. recently granted to certain engineers, be referred to the Ministry of Munitions to determine.

**Marsden.**—E.L. PROPOSALS.—The D.C. has considered the Yorkshire Electric Power Co.'s request for comments on, or amendments to, the prospective Bill in Parliament, and considers that it should retain freedom of action with regard to any supply of electricity to the district, and the clerk was instructed to reply accordingly.

**Middleton (Lancs.).**—INCREASED CHARGES.—At the last meeting of the T.C., a letter was read from the Manchester authorities with reference to the proposal to make increased charges for bulk supply of electricity taken from them. The Middleton Council has decided to increase the charges for electricity for power and lighting purposes to consumers by 12½ per cent. from January 1st last.

**Monasterevan.**—The Local Land and Labour Association has passed a resolution pledging its support to Mr. Griffith, of the Monasterevan Electric Co., in connection with the electric lighting of the town.

**Nelson.**—A Sub-Committee appointed to consider the second report of the Committee on Inter-Communication of Lancashire and Cheshire Electricity Supply systems, has passed a resolution agreeing generally with the proposal to link-up the electricity undertakings, but not with the second portion of the report proposing the conferment of additional powers upon a proposed joint board in regard to the establishment and control of future and existing power stations and high-pressure transmission lines.

**Rochdale.**—The T.C. has expressed its high appreciation of the generous action of Messrs. Thomas Robinson & Son, in voluntarily agreeing to annul a clause in their electricity contract made with the Corporation before the war, and to substitute the Committee's new scale of charges from April 1st next to March next year. It was stated that this would mean a difference of £800 to the Corporation per year.

**Salford.**—LOAN APPLICATION.—Application is to be made to the L.G.B. for permission to borrow £1,000 for land for electricity premises, and £6,200 for mains and services.

**Sheffield.**—LOAN SANCTION.—The town clerk reports receipt of sanction to the borrowing by the Corporation of £602,000 in connection with the proposed electric power station at Blackburn Meadows.

LINKING-UP.—At a meeting of the Electricity Supply Committee it was reported that a further meeting of the Joint Sub-Committee with reference to electricity supply to Sheffield, Rotherham, and other adjacent areas had been held, when certain terms were approved in connection with the proposed linking-up scheme between Sheffield and Rotherham; such terms provide that the total cost of cables and transformers, together with suitable metering arrangements, estimated at £50,000, should be apportioned equally between the two Corporations, and that the maintenance of the inter-connecting arrangements should be undertaken by either Corporation, as may be agreed, the cost being apportioned equally between them, and that the supply should be available as may be agreed between the respective engineers. It is proposed that all points of difference arising out of the proposed agreement be referred to arbitration. It is also proposed to make an application to the Ministry of Munitions for a free grant of a portion of the total cost of, and incidental to, the linking-up arrangements; Mr. Gridley, on behalf of the Ministry of Munitions, has suggested that two sets of 20,000 to 25,000 KW. should be placed on order, one for Blackburn Meadows station, and the question as to the allocation of the second set not to be definitely settled at the moment. It is understood that the cost of the scheme will be approximately £1,000,000. The Electric Supply Committee approved the proposed terms.

**Silsden (Yorks.).**—The Council, last week, considered the Yorkshire Electric Power Co.'s new Bill, but in view of the recommendations of the Government Reconstruction Committee in regard to national electricity supply, the Council left the matter over until the February meeting.

**Stafford.**—The Corporation has issued a special appeal to the residents to exercise the strictest economy in the use of electricity.

**Swansea.**—The Chairman of the Electricity Committee stated that the sanction of the Government had been obtained to the extension scheme in connection with the electricity plant, for the purpose of supplying the docks, &c.; the sanction had been given on priority, and he considered this an indication of the importance attached by the Government to the Swansea scheme and its probable scope in regard to the proposed new provisions for combination of electric light undertakings.

**Weston-super-Mare.**—PRICE INCREASE.—The Electric Supply Co. has given consumers notice that the price of energy for lighting has been increased by ½d. per unit, and for heating and power by ¼d. per unit.

**Worcester.**—At the City Council meeting, Mr. W. J. Hill referred to the report of the Coal Conservation Sub-Committee, and expressed the view that Worcester was not likely to be affected by the national scheme for many years. The Council accepted a recommendation to install new pumps and machinery at the waterworks and to utilise electricity more for pumping. A sum of £750 will be contributed by the electricity department towards the cost of cable, transformers, switchgear, and buildings, &c. There would be a guaranteed minimum demand of 400,000 units per year.

**Yeadon.**—The Council has decided to deal in Committee with the Yorkshire Electric Power Co.'s prospective new Bill in Parliament, along with a Bill by a local gas company.

**Yorks. (West Riding).**—The Law and Parliamentary Committee of the West Riding County Council recommends the Council, that unless satisfactory clauses or amendments are introduced, the Bill being promoted by the Yorkshire Electric Power Co., Bills by the Rotherham and Sheffield Corporations, and Lighting Orders asked for by the Sheffield and Halifax Corporations and the Guiseley, Clayton, and Queensbury District Councils shall be opposed in Parliament.

## TRAMWAY AND RAILWAY NOTES.

**Ashton.**—TRAMWAY PURCHASE.—Owing to the war, it has not been found possible by the Ashton Corporation to carry out the purchase of the Oldham, Ashton, and Hyde Electric Tramways. An application, however, is now to be made to the B. of T. for an extension of one year on the period of 21 years, at the expiration of which the municipal authorities were empowered to acquire the company's undertaking.

**Birmingham.**—A scheme is being formulated by which it is hoped to carry goods on a rather extensive scale on the tramways. The object is to reduce the number of horses and mechanically driven vehicles employed in the city in connection with the retail trades, having regard to the shortage of provender and petrol.

The debate was resumed on Tuesday, at a meeting of the City Council, on the important report of the Public Works Committee, which made drastic proposals for the substantial widening of the chief main arterial roads. The width proposed is 120 ft., and it is proposed to adopt a separate sleeper track for tramways. The scheme would be carried out over a long period of years, authority being given to the Public Works Committee to buy up building frontages and sites of premises as leases fell in. Street widenings had hitherto been of a piecemeal character. Mr. Neville Chamberlain expressed the view that tramways laid in macadam roads were doomed, and that there would be an enormous development of sleeper track tramways, which were in reality light railways, for passenger and goods traffic. The scheme was approved.

**Halifax.**—The T.C., last week, sent back for further consideration, the War Wages Committee's resolution viewing with alarm the continual demands of labour for more wages, and urging the Government to take measures to put a time limit on the possibility of further applications after advances have been granted.

FARE REVISION.—The T.C., after considering tramway fares in Committee, has instructed the town clerk to ask the Tramways Control Board to urge the Government to empower local tramway authorities to increase their fares beyond the limits prescribed by the local Acts, with a minimum charge of 1½d. The resolution further provided that in the event of such powers being obtained, the Halifax fares be increased by 50 per cent., except those of children and of the stage between the Post Office and railway station. It is proposed, under this idea, to issue tickets to children on the lines of workmen's tickets. The fare from the Post Office to the railway station is to be increased from ½d. to 1d. as from January 7th, the transfer system is to be abolished, and the West End circular route is to be discontinued. The Council further decided to ask the B. of T. for power to increase the motor-'bus fares.

**Oldham.**—The Tramways Committee was last week empowered to purchase a new electrical 'bus for the Coppice Post Office service. Councillor Cheetham said their history of 'buses had been unfortunate. They had never been profit-earning, and during the past 12 months they had disposed of two out of their three 'buses. The objection to the remaining one was not that it was gas-driven; in other towns electrical 'buses were satisfactory, and they had their own experience of an electrically-driven tower wagon, on which, reckoning electrical energy at 1½d. per unit, the cost of running was 1·4d. per mile.

**South Africa.**—According to the *British South African Export Gazette*, Sir William Hoy says that the electrification of the S.A. railways is a question which his department intends to tackle seriously. The Johannesburg-Durban line may receive first attention.

**Wigan.**—ACCIDENT INQUIRY.—At the adjourned inquest on the two victims of the runaway car accident at Pemberton, the driver of the car said he noticed a defect in the hand-brake before the accident. When the trolley was being changed, the car commenced to run back; he called to the conductress to replace the trolley, so as to make the magnetic brake available, but she failed, and in the scuffle he dropped his power handle. Fearing a collision, he jumped from the car. He admitted there were two other brakes he might have used, and knew that he was taking a risk in continuing the journey after finding the brake was defective, but thought he could control the car. The jury returned a verdict of "Accidental death," adding that in their opinion the driver was deserving of censure for not using more discretion. They also recommended that in future conductors and conductresses should be instructed not to remove the trolley pole until told to do so by the driver. The Coroner remarked that there seemed no doubt that had the motorman stuck to his post he might have been able to save the two lives.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Argentina.**—February 23rd. Rosario Municipality. Establishment of telephone service within the municipal radius. Conditions on application.

**Australia.**—MELBOURNE.—April 5th. Department of the Navy. Motor-driven hydraulic pump. Director of Navy Contracts, Melbourne.

**Bolton.**—January 15th. Electricity Committee. One 7,500-KW. turbo-alternator with condensing plant. See "Official Notices" December 7th.

**Manchester.**—January 16th. Electricity Committee. Rotary converter or motor converter plant. See "Official Notices" December 28th.

February 2nd. Waterworks department. Electrically-driven radial arm crane. See "Official Notices" January 4th.

**Spain.**—The municipal authorities of Astilleros (Province of Santander) have lately invited tenders for the concession for the electric lighting of the town during a period of four years. Tenders have also been invited for the concession for the electric lighting of the town of Albaida (Province of Valencia).

**Tipperary.**—January 11th. New battery for the Union electric lighting plant. See "Official Notices" December 21st.

## CLOSED.

**Bolton.**—Tramways Committee. Aron Electricity Meter, Ltd. Additional meter at the Spa Road generating station for measuring energy for tramway purposes.

**Glasgow.**—Tramways Committee :—
Dyes & Young.—Commutators.
Micanite & Insulators Co., Ltd.—Leatheroid.

**Leeds.**—Electricity Committee. 6,000-KW. turbo-generator: Richardsons, Westgarth & Co.

**London.**—HACKNEY.—B.C. Electricity Committee. Accepted tender :—One 7,500-K.V.A. turbo-alternator and auxiliary plant, £32,395 : Messrs. C. A. Parsons & Co., Ltd.

**Salford.**—Town Council. British Westinghouse Electric and Manufacturing Co., Ltd., 300-K.V.A. transformer, at £380, and an E.H.T. switch cubicle, at £265.

**Sheffield.**—City Council. Electricity and Tramway Departments :—
E. Taylor Ltd.—Construction of penstock and flushing chamber.
Wellerman Bros.—Erection of sub-station Upwell Street, £150).
S. F. Bowser & Co.—Oil storage and measuring system, together with pumps, piping, &c., £415.

**Watford.**—U.D.C. :—
Brush Electrical Engineering Co., Ltd.—Turbo-alternator, £8,980.
Stirling Boiler Co.—Boiler, £1,750.

## FORTHCOMING EVENTS.

**Electro-Harmonic Society.**—Friday, January 11th. At 8 p.m. At the Holborn Restaurant (Venetian Chamber). Smoking concert.

**Junior Institution of Engineers.**—Friday, January 11th. At 8 p.m. At 39, Victoria Street, S.W. Paper on "Construction of Post-War Aeroplanes," by Mr. F. W. Halliwell.

**London Association of Foremen Engineers.**—Saturday, January 12th. At 7 p.m. At Cannon Street Hotel, E.C. Presidential address by Mr. R. M. Campbell.

**Association of Mining Electrical Engineers (West of Scotland Branch).**—Saturday, January 12th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Cable Complaints," by Mr. J. R. C. Brooking.

**Birmingham and District Electric Club.**—Saturday, January 12th. At 7 p.m. At the Swan Hotel, New Street. Presidential Address by Mr. J. J. Richardson.

**Institution of Electrical Engineers.—(Manchester Local Section).**—Tuesday, January 15th. At 7 p.m. At the Engineers' Club. Paper on "Electrical Signalling and Control on Railways," by Mr. C. M. Jacob.

**Illuminating Engineering Society.**—Tuesday, January 15th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "Ten Years of Illuminating Engineering," by Mr. L. Gaster.

**Greenock Electrical Society.**—Tuesday, January 15th. At 7.30 p.m. Visit to Glebe Sugar Refinery.

**Belfast Association of Engineers.**—Thursday, January 17th. At 7.45 p.m. At the Municipal Technical Institute. Paper on "Past, Present and Future of the Internal-Combustion Engine," by Prof. J. H. Smith.

**Institution of Mechanical Engineers.**—Friday, January 18th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Papers on "Traction on Bad Roads or Land," by Mr. L. A. Legros, and "Utility of Motor Tractors for Tillage Purposes," by Mr. A. Amos.

## OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 81 of the ELECTRICAL REVIEW, which is now printing, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

## NOTES.

**Electrical Trade with Siberia.**—In the course of an article on "Industrial Opportunities in Siberia," published in *Russia*, Mr. C. W. Purington says :—In my various trips through the Siberian communities I have frequently inspected small steam and electric installations, and have found the electric ones, almost without exception, of German manufacture; while the steam units are usually of the German locomobile type. In the city of Vladivostock a large and handsome building stands facing the harbour on one of the main streets. The entire building was occupied by a great electrical firm of Berlin. From this office the company directed, not only the civil installations throughout the Primorsk or coast province of Siberia, but also the principal electric installations of the Russian Government. In order to install a 450-KW. American generator at Nikolaievsk in 1910, special permission was necessary from a firm of German manufacturers. Is this incident likely to be repeated? I think not. The building of that German company to which I refer is, I have no doubt, boarded up as tight as the German Embassy at Petrograd, and the German staff of the company are in safe keeping until the close of the war.

I can give one example of the former use of German electric machinery by a gold-mining company using some 20 generators and over 100 electric motors for mining purposes, in connection with five hydro-electric plants that are almost exclusively of German manufacture. This company has now decided not to purchase another pound of German machinery of any shape or description. Centrifugal pumps, direct-acting pumps, hoists, electric and steam industrial locomotives, excavating and conveying machinery are subject to the same comment. Fuse caps, quicksilver, special steels, tools of all descriptions have been for years purchased by the Siberian gold-mining companies from Germany. The Russians say: "Never again."

**Volunteer Notes.**—LONDON ARMY TROOPS COMPANIES, VOLUNTEER ENGINEERS.—Headquarters, Balderton Street, Oxford Street, W. 1.

Orders for the week ending January 19th, 1918, by Lieut.-Colonel C. B. Clay, V.D., commanding :—
*Officer of the Week.*—Second Lieut. H. J. Golding.
Monday, January 14th.—No. 3 Company, 6.30—8.30. Recruits' Drill, 6.30—8.30. Signalling Section, 6.30—8.30.
Tuesday, January 15th.—Lecture on "Demolitions," 6.30. Physical Drill and Bayonet Fighting, 7.30.
Wednesday, January 16th.—No. 1 Company, Drill, Knotting, &c., 6.30—8.30. Recruits' Drill, 6.30.
Thursday, January 17th.—No. 2 Company, Drill, Knotting, &c., 6—8. Recruits' 6.30—8.30. Signalling Section, 6.30—8.30. Ambulance Section, 6.30—8.30.
Friday, January 18th.—Musketry, 6.30—8.
Saturday, January 19th.—Entrenchments, &c., 2.45—4.45. Recruits' Drill, 2.45—4.45.
Special Notices.—All drills and parades will be at Headquarters unless otherwise stated.
Recruits will attend for Engineering Instruction with the Companies.
(By order) MACLEOD YEARSLEY, *Capt. and Adjutant.*

**Electric Steel.**—The London Foundry Co., Ltd., whose works are near Enfield, with one electric furnace at work, in five months made a net profit of £9,200; but the rate of profit in the fifth month was more than double that in the first month, and it is estimated that with two additional furnaces in operation a net profit of £60,000 a year will be attained. The company makes high-class steel and steel alloys, mostly nickel steel, nickel chrome steel, and high-carbon tool steel, from scrap steel. In addition to the foregoing products, the whole of which are required for war purposes, steel wheels and other castings for motor lorries are made.

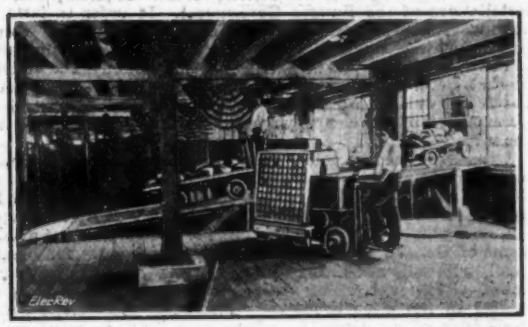
In view of the pressing demand for the company's products, every effort is being made to complete extensions to the works, and within a few months, with three furnaces each of 3 tons capacity, and new generating and foundry plant, the output of the works will be 600 tons of steel per month. The orders in hand are said to be sufficient to keep the present plant working at its maximum output day and night till next August.

An article by Mr. John A. Holden in the *Iron and Coal Trades Review* states that a few years ago steel turnings could be bought for 30s. per ton; the price to-day for the same metal is about £4 per ton, the raw material for the manufacture of electric steel in the arc type of furnace consisting almost entirely of turnings. Fifty 3-ton electric furnaces would consume annually 150,000 tons of steel turnings. For producing electric carbon tool steel, mild-steel turnings from shells are in much demand. Nickel-steel turnings are used for the manufacture of nickel-steel ingots. With a suitable grade of scrap no addition of nickel may be required, because in any type of electric furnace there is no oxidisation of nickel. Similarly, nickel-chrome-steel turnings may be profitably converted into nickel-chrome-steel ingots. In acid-lined furnaces there is little or no loss of chromium; in fact, the reactions in this furnace are comparable to those of the crucible process. In basic-lined furnaces chromium may be retained or eliminated. In the former case the phosphorus would not be so completely oxidised, but, nevertheless, it would be confined to safe limits. It follows that for the cheap production of alloy steels, such as nickel and nickel-chromium, scrap turnings containing the necessary elements should be used.

From an economic point of view, it is undesirable that alloy-steel turnings should be used in charges where the alloying elements are not necessary or desirable. Many engineering establishments do not keep all these varieties of scrap separate. Fifty tons of 3 per cent. nickel-steel scrap contain £300 worth of nickel. Taking 50 tons as a weekly average, it represents potentially £15,000 per annum.

**Electric Industrial Trucks.**—Statistics prove that the electric industrial truck can replace from three to five men, who are thus released for meeting unusual demands for men—and more men, and these economic units also show an increase in the handling speed.

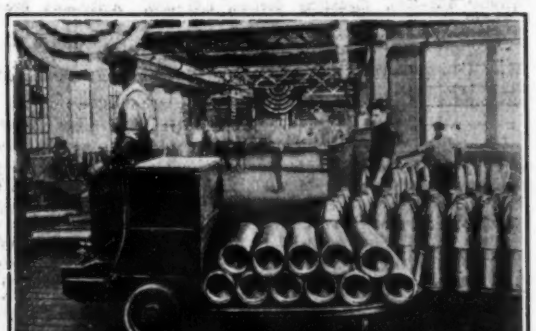
New uses for the industrial truck are constantly being found. Several years ago the U.S. Government adopted them for use in its arsenals, and following England's precedent, practically all the factories making munitions are now using these "electrics," and are finding them indispensable. Some manufacturers use conveyors, but the munition men found that the storage battery truck met their requirements much more suitably, first, because the electric industrial truck could do all and more than a conveyor at a much less cost;



INDUSTRIAL TRUCKS CARRYING 4,000-LB. LOADS UP INCLINE.

secondly, because there was the danger of friction with conveyors; and thirdly, because trucks are more mobile. Special models have been designed with separate compartments for the transportation of shrapnel and other shell, and large numbers of these trucks are being operated by women.

The trucks are made small enough to operate in the aisles of factories and storage warehouses, to run on elevators and into freight cars, yet their standard capacity is two tons. Many of them carry loads up to 20,000 lb., and can climb grades too steep



ELECTRIC INDUSTRIAL TRUCK IN AMERICAN FACTORY.

for hand trucks. Elevating transfer trucks have also been developed which can pick up, carry away, and set down loaded interchangeable platforms, thus eliminating hand labour in loading and unloading the trucks.

A prominent petrol car company has a fleet of 49 electric industrial trucks, and in its plant, which covers about 110 acres of floor space, the average hauls are 150 ft., and these little trucks successfully pull loads up 12 per cent. grades. The entire fleet is housed in an 80 × 80 ft. garage. The operating record of a two-ton truck was kept during one month, and the average cost per ton-mile was:—Labour, $2·040; power, $·066; maintenance, $·010; investment and depreciation, $·017, making a total cost per ton-mile of $2·133. This truck averaged 3·7 miles per day loaded, plus the same mileage empty, and its average daily total tonnage was 14·1. A single example of the labour saving effected in one department of this plant plainly proves the economy of the industrial truck. Eighteen men were formerly needed to unload storage batteries from freight cars; eight men with one electric industrial truck now do the same work, and do it faster.

**British Electrical Propaganda.**—The British Electrical and Allied Manufacturers' Association has issued two special issues of the B.E.A.M.A. *Journal* for propaganda purposes in Spain and Russia on behalf of British manufacturers. They contain articles calculated to impress readers in these two countries with the ability of our electrical manufacturers to cater for the electrical requirements of Russian and Spanish-speaking purchasers. In addition to special articles on such subjects as railway electrification and textile factory installation work carried out by British engineers, there are numerous illustrated notices of machinery and apparatus manufactured by B.E.A.M.A. members. We hope that the circulation of literature of this description will help to strengthen the position of our firms abroad at the present important stage of our history.

**The Position in Spain.**—A correspondent in Spain writes:—The shortage of coal is causing serious trouble to many supply companies. For the past month the "Compania Sevillana de Electricidad," of Seville, has received only half the quantity necessary for the normal output, and many factories in the district were shut down for lack of motive power. Rioting of the unemployed workmen followed, and an attack was made on the power house, resulting in nothing more serious than broken windows. An arrangement has now been come to, the consumption of energy for lighting purposes being restricted to certain hours, and the coal thus saved is being used for the day power load.

In order to prevent shortage of current in the mines of Murcia and in other industries employing thousands of workmen, the "Sociedad Hidro-Electrica de Espana" has been ordered by the Government Commission of Supply to refuse public supply between the hours of mid-day and 2 p.m. at its steam-driven power houses in the provinces of Murcia, Madrid, Valencia, and Alicante. For the same reason the tramway services in Madrid and Valencia are to be stopped between 1 a.m. and 6 a.m.

In La Union (near Cartagena) the merchants have sent a petition to the supply company demanding an efficient supply of current within two days, failing which they will shut down their factories and close their shops, will organise a procession in the streets, and will, further, refuse to pay accounts for energy supplied.

**Electrical Resistivities of Iron Alloys.**—A recent article by Mr. T. S. Fuller, of the Research Laboratory of the General Electric Co. (U.S.A.), in the *General Electric Review*, contains some interesting data on the above subject, obtained from an investigation of the electrical resistivities of a series of iron alloys. Most of these were melted either in an atmosphere of hydrogen or in a vacuum; the component metals used were Swedish iron, Goldsmith chromium and manganese, nickel, and cobalt, 98-99 per cent. pure. Portions of the 100 gramme melts were swaged and drawn down to wire of ·01 in. diameter, and all the alloys mentioned are sufficiently ductile for wire drawing. The samples were annealed, and the resistance measured at room temperature by means of a potentiometer using the null method.

Alloys can be divided into three characteristic groups as regards resistivity; in the first (examples being tin-zinc, tin-lead, tin-cadmium, &c.), the resistivity can be calculated directly from the components, if the concentration by volume is known; in the second group (gold-silver, copper-nickel, iron-nickel, &c.), the alloy resistivity is much greater than that of either of the components. The components of the first group represent a mechanical mixture, in the second group they are in solid solution, in a third group they are present in a semi-miscible state, that is, one in which two series of solid solutions are separated by a gap; examples of this group are copper-silver, copper cobalt, &c. All the systems considered by the author belong to the second group. The iron-nickel alloys range in resistivity from the values for iron and for nickel up to a maximum of 86·3 microhms per cm.$^3$ (Fe 66 p.c., Ni 34 p.c.). The alloys containing large amounts of iron are readily oxidised, and should not be used unprotected at temperatures above 400-500° C.

The iron-chromium series presents only a small difference in resistivity for alloys containing 10, 20 and 30 per cent. chromium; the addition of 10 per cent. Cr increases the resistivity five-and-a-half times, and gives a value 32 times the resistivity of copper. The more Cr present the greater the resistance to oxidation at high temperatures; alloys containing 20 per cent. or more of Cr may be safely used up to 800° C. Alloys containing 80 p.c. Fe and 20 p.c. Cr, and 78 p.c. Fe and 22 p.c. Cr, have a resistivity of 60 microhms per cm$^3$.

The addition of about 30 per cent. of cobalt to iron about doubles the resistivity: like the iron-nickel series, the iron-cobalt alloys are readily oxidised at high temperatures, and should not be used above 400-500° C.

Data of the iron nickel-chromium system shows resistivities ranging from 11·8 to 12 microhms per cm.$^3$ for nickel and iron individually, to 113 microhms per cm.$^3$ (Fe 20 p.c., Ni 55 p.c., Cr 25 p.c., or Fe 10 p.c., Ni 53 p.c., Cr., 37 p.c.), this figure being 66 times the resistivity of copper.

The only alloys of this group which are not highly resistant to high temperature oxidation are those containing large amounts of Fe and less than 20 per cent. of Cr. All others resist oxidation to a high degree. Those alloys containing large amounts of Ni and 20 per cent. or more of Cr are the most resistant to oxidation, and may be used at temperatures up to 1,000° C. Alloys containing up to and including 37 per cent. Cr were made; this is the limit of forgeability. The iron-nickel-manganese alloys have resistivities up to 103 microhms per cm.$^3$ (Fe 55 p.c., Ni 36 p.c., Mn 9 p.c., or Fe 53 p.c., Ni 36 p.c., Mn 11 p.c.). These alloys are readily oxidised at high temperatures, and should not be used above red heat.

What has been said of the iron-nickel-chromium system applies equally well to the iron-nickel-chromium-manganese alloys. Those having a high nickel and chromium content are resistant to oxidation at high temperatures, and may be safely used up to 1,000° C. Resistivities of 111 microhms per cm.$^3$ are obtained with Fe 42 p.c., Ni 39 p.c., Cr 16 p.c., Mn. 3 p.c., or Fe 34 p.c., Ni 50 p.c., Cr 10 p.c., Mn 6 p.c.

Six tables, showing the resistivity of alloys of varying composition, are included in the article.

**An Investigation of Air Pumps.**—The important departure by the North-East Coast Institution of Engineers and Shipbuilders in appointing a Committee of expert engineers to test apparatus offered by manufacturers and accepted by the Council has resulted in a very comprehensive report on the working of air pumps, such as are used in connection with the condenser plant of steam engines. The manufacturers in this case were Messrs. Richardsons, Westgarth & Co., Ltd., and the tests were carried out at their Hartlepool works.

The investigations undertaken by the Institution will include air pumps of the reciprocating type and of the rotary and jet types. The present report deals with tests made on pumps of the reciprocating type only, and the point of chief technical interest is the fact that the tests have demonstrated that remarkable influence in the withdrawal of air from a condenser is possessed by a steam jet, or a series of jets, when used in combination with such pumps.

The original conception of combining a steam jet with an air pump was due to Mr. James Atkinson, of London, who in 1886 proposed it in connection with the cooling of liquids under high vacuum. In 1902 it was developed by Sir Charles Parsons in his vacuum augmentor for use with steam engine condensers, and at later dates it has been further considerably improved by Mr. D. B. Morison, of Hartlepool. These improvements, known as the Kinetic system, are dealt with in the report, together with the "wet and dry" and other systems now in general use.

The report demonstrates beyond question that no mechanical contrivance is so simple and so efficient as a steam jet for compressing a large volume of highly attenuated air through a small degree of compression, and, as is already well known to engineers, a reciprocating air pump is a very efficient means for discharging moderate volumes under a high degree of compression. Consequently, the correct solution of the problem of air discharge from a condenser is to withdraw a large volume of aerated vapour by means of one or more steam jets, and compress it through the range of compression in which the steam jet works with very high economy, and then pass it on at such an absolute pressure that an air pump or other device can discharge it to the atmosphere also with very high economy.

The report shows that for a given duty the employment of a steam jet on the Kinetic system will allow the speed of a given pump to be reduced from 60 strokes per minute to 20, and the consumption of steam to be reduced by one-third, the pump mechanism remaining exactly as at present. Alternatively and obviously, an independently driven pump may be made smaller for a given duty.

**Restricting Shop Lighting.**—The first order has just been issued under the new Defence of the Realm Regulation which empowers the Minister of Munitions to restrict the use of any form of artificial light. On the ground that "it has become necessary for the maintenance of the supply of power for the production, repair, and transport of war material and for other work necessary for the successful prosecution of the war to restrict the use of lights for certain purposes in the area," Mr. Churchill has decided that in the County Borough of Derby no light shall be used in any shop front on any week day, other than Saturday, after 3.30 p.m. or during any period of abnormal darkness occurring at an earlier hour. The prohibition does not extend to any light approved by the chief officer of police as necessary for the serving of customers inside a shop, or to any light used solely for illuminating a small sign in a shop front to indicate to persons outside that the shop is open for the serving of customers.—*Daily Telegraph.*

**Electrical Workers' Bonus.**—Toward the end of last week it was noised abroad in London that a strike of electrical workers in the metropolis was imminent. It appears from the newspaper Press reports that the Electrical Trades Union held a meeting in London on Thursday, January 3rd, at which expression was given to the feelings of discontent that existed because their members had not received the 12½ per cent. war bonus that had been granted to the great majority of workers in the controlled establishments several months ago. There were threats of a strike unless the advance were conceded by the Ministry of Munitions. In the course of Saturday Sir George Askwith got into touch with the Union, and proposed that the men should remain at work on the understanding that there should be a conference on the matter on Monday. The trouble involved electrical workers in power stations and newspaper and other offices, as well as controlled establishments. The conference duly took place on Monday. In an interview which a *Daily Mail* representative had with Mr. W. J. Webb, the District Secretary of the Union, that gentleman remarked:—"This 12½ per cent. bonus has caused more trouble in the Labour world than anything else. It has been granted to many of the least indispensable workers in other trades, and refused to highly skilled electrical workers. Labourers and men who sweep floors are getting more money than some of our skilled mechanics." According to a similar interview in the *Times*, the difficulty arose through references to several Committees and the apparent lack of finality. As an instance of the peculiarity of the advanced wages, reference was made to one department where a skilled man was receiving 1s. 2½d. per hour, while a labourer was paid 1s. 3d. per hour and a bonus! The right to the 12½ per cent. advance was claimed in accordance with the Government order of October last affecting wages in the engineering and foundry trades.

The conference on Monday is stated to have lasted eight hours. Sir George Askwith, as Chief Industrial Commissioner, met representatives of the employers and of the Union. According to the *Times*, the conference lasted so long owing to the reluctance of some of the employers to agree to make the payment of the bonus retrospective. In the end the advance was agreed to, and it takes effect as from October 13th last. We are indebted to the *Times* for the following report of the terms of the award:—

"All plain time-working employés in generating stations, substations, and on mains directly concerned in the generation and distribution of electrical energy, including the technical staff, and, in the case of electrical contractors, employés engaged on munitions work, including the technical staff, shall receive a bonus as follows:—

"1. All workers who have received not more than 20s. war advance, the equivalent of 12½ per cent. on earnings; any advance given by a pending decision of the Committee on Production, or any advance given by agreement or otherwise, equivalent to the advance of 5s. granted by the Committee on Production to certain trades from the first full pay day in December, to be added as a war advance to the advance already given, and to count as part of the earnings from the date of such advance.

"2. All workers who have received over 20s. war advance sufficient to produce the equivalent of the 20s. plus 12½ per cent. on earnings, that is to say, any excess in war advances over 20s., shall merge in the 12½ per cent. on earnings.

"3. Workmen who have received the equivalent of 20s. war advance plus 12½ per cent. on earnings, or more, are not affected by this settlement. In calculating whether 20s. has been received it shall be taken as 20s. for the normal week as recognised in the district.

"4. Basis rates of wages and conditions of labour shall remain as at present until the withdrawal of war wages and war bonuses. This clause is without prejudice to pending negotiations, if any, which may have commenced.

"5. This decision shall take effect as from the beginning of the first full pay the next after October 13th, 1917."

The result was announced on Monday night to a crowded meeting of members which was waiting for the news at the Holborn Town Hall.

**Leeds Telephone Service.**—The transition of the Leeds telephone service to the automatic system, the preliminary arrangements for which have been in progress for several months past, will be accomplished in a few weeks' time. The actual change will be made almost instantaneously, without any delay or suspension of the service. Mr. T. B. Johnson, the superintending engineer, announces that due notice will be given to subscribers as to the exact moment of the changing over. In a minute's time the old order will be disconnected, and every line in Central Leeds will be immediately connected to the new system. All numbers will be changed to bring them to a figure exceeding 10000—2873, for instance, becoming 12873. This alteration is to ensure that the initial figure will always signify the same thing, and so set the automatic machinery in running order. In the case of a subscriber having several instruments, where all but one are engaged, the automatic call will come to the disengaged instrument. So far, Leeds is the largest telephone exchange in the world to be converted to the automatic system, the experiments already carried out in London, Portsmouth, Accrington, Epsom, and Hereford all being on a smaller scale. The automatic exchange at Chicago, which is larger than any in this country, was built directly for the system without transfer.

**Supplies of Gas Coke in the Metropolitan Area.**—Owing to the presence of large stocks of gas coke at London gas works, the Controller of Coal Mines has agreed that any consumer who has already put in some form of requisition for coal or coke under the Household Coal Distribution Order, 1917, may purchase in addition, either directly or through his coal merchant, a supply of coke not exceeding 5 tons, provided that arrangements can be made for delivery before February 1st next. This supply of coke is additional to any quantity included in the allowance under the requisition, and must be gas coke manufactured within the Metropolitan coal area.

**Appointments Vacant.**—Charge engineer for Bootle Corporation (£150 + war bonus £31 4s.); temporary engineer-in-charge (£3) for the Bermondsey B.C. Electricity Department; assistant engineer, or fitter-driver, for the Sale U.D.C. Electricity Works; charge engineer for the Wakefield Corporation Electricity Department (49s. 6d.); junior shift engineer for Birmingham Corporation (£130 + extras); test room superintendent for the Halifax Borough Electricity Department. See our advertisement pages to-day.

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*

**Central Station and Tramway Officials.**—Mr. J. BANCROFT HUDSON, deputy borough electrical engineer, Bootle, was presented with a solid silver tea service and framed photograph of the staff on leaving to take up the position of borough electrical engineer and manager at Leigh. The presentation was made by Mr. T. Dawson Clothier, the borough electrical engineer.

Mr. J. A. VICE, shift engineer at the Manchester Corporation's city electrical stations, has been appointed shift engineer at Stuart Street station at £240 per annum.

Bedford T.C. has appointed Mr. A. H. BULLEN, of Stoke-on-Trent, as mains superintendent, out of 20 applicants.

St. Helens T.C. has advanced the salary of the electrical engineer, Mr. E. M. HOLLINGSWORTH, from £550 to £575 a year, as from November 1st last, with a further advance of £25 from November 1st next; and that of Mr. H. C. DUNCAN, commercial assistant at the electricity works, from £150 to £175 a year, from April 1st next.

The Manchester City Council had before it on Wednesday last week a resolution of the Tramways Committee, sanctioning the transfer of Mr. J. M. MCELROY, the general manager of the tramways department, from the Admiralty to the Board of Trade, so as to enable him to serve on the committee of tramway experts recently appointed by the Board, and that the request of the Admiralty that they may be permitted occasionally to utilise Mr. McElroy's services for special work in connection with the department in which he has been serving be acceded to, it being understood that Mr. McElroy will attend in Manchester to all matters of special importance arising in connection with the work of the Tramways Committee.

Mr. C. H. DAVIES, station superintendent to the Stalybridge, Hyde, Mossley and Dukinfield Electricity Board, who recently received an appointment under the Admiralty, was presented with a silver tea service by the electrical staff of the Board before finally relinquishing his duties at Stalybridge last week.

The York E.C. reports that the engineers at the generating station have applied for an increase of wages, and recommends that they be granted £50 each per annum, in addition to war wages and bonus. The Committee explains that the claims of the Army for young men, and the enormous amount of munitions work, have made the demand for trained engineers so great that they are able to command considerably higher salaries than has hitherto been the case. The Committee reports:—"Since the last meeting of the Committee one of the engineers has resigned, and should the Committee be unable to retain an adequate and competent qualified staff the undertaking would cease to be in a position to supply electricity. Apart from the laws of supply and demand, the Committee feels that the charge engineers have specially responsible work at times like these, when air-raid warnings have to be dealt with, and supervision has to be carefully carried out, and they think the Council will realise that the alternative to meeting the request of these officers for an increase of salary must undoubtedly be avoided."

On his resignation from the electrical staff of the Dublin United Tramways Co. (Ringsend power station), Mr. J. P. WALSH has been presented by his colleagues with a gold watch.

Mr. W. M. MILES, analytical chemist to the Sheffield electric supply department, has been permitted to undertake analyses of coal samples for the Coal Control Department, which will pay him an honorarium at the rate of £50 per annum.

**General.**—The directors of the North British & Mercantile Insurance Co. have appointed Mr. JOHN E. BELL, A.I.E.E., who received his early training at Newcastle Branch, and for some time past has been employed at the company's Edinburgh office as electrical inspector and surveyor, to be second officer at the company's Newcastle branch, with the title of "sub-manager."

The *London Gazette* contains the following announcement:—"Royal Engineers, T.F., Second-Lieutenant to be Lieutenant, H. NIMMO. December 21st, 1917." Lieutenant Nimmo before joining the Army was officiating head of the electrical branch of the Burma Public Works Department. Previously he was with the Rangoon Electric Tramways & Supply Co., Ltd., and the Irrawaddy Flotilla Co., Ltd., of Rangoon.

Mr. L. FRAYNE BOYES, for some time chief outside representative for Scotland for the General Electric Co., Ltd., and well known in Clyde shipbuilding circles, subsequently representing the British General Electric Co., Ltd., of Australasia, in Adelaide, South Australia, is now Investigator and Assistant to Advisers, Priority Permits Branch, New Zealand Munitions Department, Wellington.

The marriage took place at Melmerly Parish Church, on December 29th, of Mr. ROBERT JOHN HALLIBURTON BEATY, A.M.I.E.E., and Miss Edith Westmorland.

Mr. ARTHUR WILLMOTT, A.M.I.E.E., has resigned his position (after 11 years) as works manager of the Electric and Ordnance Accessories Co., Ltd. (Vickers, Ltd.), Birmingham, and is taking up the post of general manager with Messrs. A. A. Lyon & Wrench, Ltd., Victoria Road, Willesden.

**War Honours.**—We congratulate the following upon the recognition that has been accorded to them in the War Honours List, published on Tuesday last, for their services rendered in connection with the war:—

*Order of the British Empire.* Knight Commanders (K.B.E.):—

A. J. Dorman, Esq., chairman, Dorman, Long & Co., Ltd.
Lieut.-Col. Henry Fowler, chief mechanical engineer, Midland Railway, and superintendent of the Royal Aircraft Factory, Farnborough.
James McKechnie, Esq., managing director of Vickers, Ltd., Barrow.
Col. A. M. J. Ogilvie, C.B., R.E., Second Secretary to the Post Office.
F. G. P. Preston, Esq., chairman, J. Stone & Co., Ltd.
C. I. Stewart, Esq., Public Trustee.
P. K. Stothert, Esq., West of England Munitions Board.
W. Rowan Thomson, Esq., Director of Auxiliary Ships' Engines, Controller's Department, Admiralty.

*Commanders* (C.B.E.):—

R. W. Allen, Esq. (W. H. Allen, Son & Co., Bedford).
Major C. J. B. Cooke, chief mechanical engineer, L. & N.-W. Railway.
A. E. Hadley, Esq., Assistant Controller of Inspection of Munitions.
T. R. Marsden, Esq., managing director, Platt Bros. & Co., Oldham.
R. E. L. Maunsell, Esq., mechanical engineer, S. E. & Chatham Railway.
T. Worthington, Esq., late Chief of the Board of Trade Commercial Intelligence Department.

*Officers* (O.B.E.):—

A. E. Berriman, Esq., chief engineer, Daimler Co., Ltd.
D. A. Bremner, Esq., late Head of the Aluminium Section, Ministry of Munitions.
A. D. Constable, Esq., Superintending Electrical Engineers' Department, Admiralty.
W. J. Glenny, Esq., Chief Staff Officer, Commercial Intelligence Department, Board of Trade.
E. Gomersall, Esq., Superintending Engineer, G.P.O.
J. A. Harker, Esq., D.Sc., F.R.S., Munitions Inventions Department.
W. E. Ireland, Esq., late Chief Engineer, Metropolitan Munitions Committee.
P. Matthey, Esq., managing director, Johnson, Matthey & Co., Ltd.
J. McCaffery, Esq., Superintending Electrical Engineer's Dept., Admiralty.
W. McClelland, Esq., Electrical Engineering Assistant to Director of Dockyards and Repairs, Admiralty.
R. McLaren, Esq., of Messrs. Babcock & Wilcox, Ltd.
A. Moir, Esq., Metropolitan Superintending Engineer, G.P.O.
L. Newitt, Esq., Electrical Engineer, H.M. Dockyard, Chatham.
E. Robinson, Esq., manager, Vickers, Ltd., Sheffield.
F. E. Smith, Esq., Superintendent, Electrical Department, National Physical Laboratory.
J. Taylor, Esq., manager, Mather & Platt, Ltd.
H. Walker, Esq., Clark, Chapman & Co., Ltd.
A. A. Carnegie, Esq., Commander of Cable Steamer *Patrick Stewart*.

The list also contains a lengthy section of Members (M.B.E.).

**Roll of Honour.**—The Grimsby Town Council has congratulated Lieut.-Col. VIGNOLES, the borough electrical engineer, on his recent promotion, and Sergeant NUTTALL, an employé of the electric lighting station, upon winning the D.C.M.

Gunner C. NELSON, R.F.A., who has died from wounds, enlisted when 18 years of age, and when employed as an electrician at Blackpool Tower.

Private H. V. ATKINSON, Lancashire Fusiliers, formerly an employé at Burnley tram shed, was killed in action on December 25th, the day before he should have had the ribbon of the Military Medal pinned on his breast.

Private J. MACINTOSH, of the Border Regiment, who has been killed in action, was an apprentice with the British Westinghouse Co., Ltd., Trafford Park.

Captain F. B. F. HARGREAVES, South Lancashire Regiment, recently reported missing, is a prisoner of war in Germany, and suffering from slight wounds. He was the chief accountant to the Blackpool & Fleetwood Tramroad Co., Ltd.

Private L. HOLLAND, Grenadier Guards, who has fallen in action, enlisted whilst with Messrs. Bullers, Ltd., electrical china manufacturers, of Hanley.

Cable Operator S. A. BREMNER, of the Eastern Telegraph Co., Ltd., has died from consumption contracted whilst on service.

Captain P. H. DI MARCO, A.M.I.E.E., R.E., formerly general manager of the Barnsley & District Electric Traction Co., has relinquished his commission on account of wounds and ill-health, and is granted the honorary rank of Captain. On leaving Barnsley, he joined the headquarters staff of the British Electrical Federation of London.

Private L. J. CARTER, Essex Regiment, formerly with the Marconi Wireless Telegraph Co., Ltd., has, on account of wounds, had his right leg amputated. He is in hospital at Port Said.

Sergeant A. W. HUGHES, R.E., who enlisted from the Rugby workers of the B.T.H. Co., has been mentioned in dispatches by Sir Douglas Haig, and has been given a card of recognition from the General Commanding the Division for distinguished conduct in the field.

Private J. H. BROOKS, South Lancashire Regiment, formerly on the staff at the electric sub-station on the Holcombe Branch Railway, Ramsbottom, has died in hospital at Oswestry from pneumonia.

Private T. GIBSON, late of the telegraph department of the Glasgow & South-Western Railway Co., has fallen in action in France.

Captain (Temp. Major) HARRY RICHARDSON, R.E., Dundee, has been awarded the Military Cross. The Major is the general manager and engineer of the Dundee Corporation electricity department, and has been at the Front for two and a half years. He has been previously mentioned in dispatches for distinguished service at the Front.

Sapper R. F. UNSWORTH, R.E., who has died in Salonika, from dysentery, aged 19 years, was employed at the works of the Corlett Electrical Engineering Co., Ltd., Wigan.

Private R. C. CRANSTON, Lancashire Fusiliers, killed in action on Christmas Day, was formerly employed in the offices of the British Westinghouse Co., Ltd., Trafford Park.

Sergeant J. CRESSWELL, Lancashire Fusiliers, who has been killed in action, after being three times wounded, was an electrician with the Midland Railway Co.

The Military Medal has been awarded to Lance-Corporal G. PRECIOUS, West Yorks. Regiment, who was with the Bradford Corporation tramways department.

Private R. HILLS, London Regiment, formerly in the general office of the India-Rubber Co., Silvertown, has been killed in action in France. Corporal W. BROWN, R.F.A., has been severely wounded, Lance-Corporal G. PETERS, Royal Fusiliers, and Rifleman W. OVENS, K.R.R., have each been wounded a second time. All were in the proofing department at Silvertown.

## NEW COMPANIES REGISTERED.

**Amalgamated Tanneries, Ltd.** (149,278).—Private company. Registered January 1st. Capital, £3,000 in 2,000 6 per cent. pref. shares of £1 each, and 20,000 shares of 1s. 6d. each. To take over the business carried on by the British Electric Tanning Syndicate, Ltd., at Langport, Somerset, and to carry on the business of tanners, dealers in hides and tanning materials, &c. The subscribers (each with one share) are:—S. L. Evans, The Tannery, Langport, tanner; J. Brown, Huish Episcopi, Langport, tanner. The first directors are:—S. L. Evans and J. Brown. Registered office: The Tannery, Huish, near Langport, Somerset.

**Zwicky Patents Syndicate (1917), Ltd.** (149,248).—Private company. Registered December 28th. Capital, £1,000 in £1 shares. To adopt an agreement with a syndicate of similar name (in liquidation) to acquire patents, to manufacture and deal in articles capable of being used in connection with electricity, heat, water, gas, ventilation, sanitation, construction, and otherwise, &c. The subscribers (each with one share) are:—W. H. Cole, 50, Brownswood Road, N. 4, solicitor's clerk; G. Kingsley, Winchester House, E.C. 2, merchant. The first directors are to be appointed by the subscribers. Solicitors: Richardson, Sowerby, Holden & Co., 5, John Street, Bedford Row, W.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Hong-Kong Tramway Co., Ltd.**—Satisfaction to the extent of £500 on June 25th, 1917, of trust deed dated July 1st, 1903, securing £195,000.

**Jarrow & District Electric Traction Co., Ltd.**—Satisfaction to the extent of £10,800 between October 1st, 1913, and December 12th, 1917, of debentures dated August 3rd, 1910, securing £15,000.

**Nairobi Electric Power & Lighting Co., Ltd.**—Satisfaction to the extent of £4,000 on December 31st, 1917, of debentures dated 1913-15, securing £20,000.

**Insulated Cap & Rivet Co., Ltd.**—Debenture dated December 21st, 1917, to secure £3,000 charged on the company's interest in certain premises at Junction Road, Highgate, and its general assets. Holders: Rolls-Royce, Ltd.

**Bogota Telephone Co., Ltd.** (69,059).—Capital, £45,000 in 20,000 pref. and 25,000 def. shares of £1 each. Return dated November 29th, 1917. 20,000 pref. and 18,607 def. shares taken up; £29,607 paid on 11,000 pref. and 18,607 def.; £9,000 considered as paid on 9,000 pref. Mortgages and charges: Nil.

**Cambridge Scientific Instrument Co., Ltd.**—Charge on the company's undertaking and assets (subject to £12,000 debentures authorised), dated December 17th, 1917, to secure all sums owing to H. Darwin in respect of his guarantee of the company's banking account for an amount not exceeding £10,000.

**City of Oxford Electric Tramways, Ltd.**—Satisfaction to the extent of £1,100 between February 22nd and December 13th, 1917, of charge dated February 20th, 1914, securing £46,000.

**Rhondda Tramways Co., Ltd.**—Satisfaction to the extent of £4,300 on December 14th, 1917, of charges dated 1911-15, securing £250,000.

**Bogota Telephone Co., Ltd.** (69,059).—Capital, £45,000 in 20,000 pref. and 25,000 def. shares of £1 each. Return dated November 29th, 1917. 20,000 pref. and 18,607 def. shares taken up. £29,607 paid on 11,000 pref. and 18,607 def.; £9,000 considered as paid on the remaining pref. Mortgages and charges: Nil.

**Brecknell, Munro & Rogers, Ltd.**—Capital, £20,000 in 2,000 pref. shares of £5 each and 20,000 ord. shares of 10s. each. Return dated November 19th, 1917. 1,058 pref. and 14,829 ord. shares taken up. £5,673 10s. paid on 1,058 pref. and 767 ord.; £7,031 considered as paid on the remaining ord. Mortgages and charges: £7,900.

**Christy Bros. & Co., Ltd.** (90,039).—Capital, £12,000 in 9,000 ord. and 3,000 def. shares of £1 each. Return dated August 31st, 1917. 7,926 ord. and 3,000 def. shares taken up. £1,826 paid; £9,100 considered as paid. Mortgages and charges: £4,600.

## CITY NOTES.

**German Companies.**

*The A.G. für Elektrizitäts Anlagen, of Berlin*, which has a share capital of £500,000, and loans amounting to £294,000, reports a decline in the gross profits on the company's investments in supply undertakings for the year 1916-17, and an increase in the working expenses. As net profits, the accounts exhibit the sum of £31,000, as compared with £42,000 in 1915-16, and the directors recommend a distribution of 6 per cent., this contrasting with 8 per cent. in 1915-16, and in each of the four preceding years.

The accounts of *Siemens & Halske A.G.* for the year ended on July 31st, 1917, after allocating £75,000 to the Siemenstadt War Care Foundation, as in the previous year, show net profits of £643,000, as compared with £625,000 in 1915-16. It is proposed again to pay a dividend of 12 per cent., to transfer £100,000 to the special reserve fund, as in the preceding year, grant £60,000 as bonus to staff and workmen, and place £25,000 to the disposition fund, leaving £64,000 to be carried forward, as against £60,000 in 1915-16.

The report of the *Elektrische Licht und Kraftanlagen A.G., of Berlin*, which is an investment company, refers to the year 1916-17, and gives particulars concerning the position of various Russian undertakings, as well as that of the concerns in Germany in which the company holds interests. The accounts show net profits of £91,000 on an ordinary share capital of £1,500,000, and loans of £1,830,000, as contrasted with £83,000 in the preceding year. It is proposed to pay a dividend of 5 per cent., being the same rate as in 1915-16 and in each of the two previous years.

The financial statement of the *Siemens-Schuckert Werke* indicates gross profits of £1,310,000 for the year ended on July 31st, 1917, as contrasted with £1,274,000 in the preceding year. After deducting general expenses and interest charges, the net profits are returned at £793,000, as against £765,000 in 1915-16. The dividend is at the rate of 10 per cent., as in the previous year; £125,000 is transferred to the reserve fund, as in 1915-16, £100,000, as against £75,000, allocated as bonus to the staff and workmen, and £25,000 put to the disposition fund, as in the previous year. The War Care Foundation receives £75,000, and £18,000 is carried forward, these contrasting with £75,000 and £15,000 respectively in the preceding twelve months.

The accounts of *Siemens Elektrische Betriebe A.G., of Berlin*, exhibit net profits of £83,000 for 1916-17, as compared with £83,000 in the preceding year. The directors recommend the payment of 5 per cent., as in 1915-16.

*The Bergmann Elektrizitäts Unternehmungen A.G., of Berlin*—the financial undertaking of the Bergmann Co.—states that the construction of the Magdeburg-Schonebeck suburban line had to be suspended owing to the war. The recovery of a portion of the outstanding debts caused the deficit to be reduced from £21,000 to £14,000 on a paid-up capital of £300,000.

*The Rhein Schuckert Gesellschaft, of Mannheim*, reports net profits of £46,000 for 1916-17, as contrasted with £45,000 in the previous year. A dividend of 5 per cent. is in contemplation, being the same as in 1915-16. It is now intended to change the title to that of the Rhenish Electricity Co., and to extend the scope by embarking on the construction of electrical and other machinery.

*The Woton Werke A.G., of Leipzig*, reports the allocation of £14,000 to depreciation in 1916-17, as against £5,600 in the previous year, leaving net profits of £30,000 and £16,000 in the two years respectively. A dividend at the rate of 40 per cent. has been declared on the share capital of £40,000, this comparing with 25 per cent. in 1915-16. As a result of the great demand, the company acquired machine-tool works at Plagwitz, and the share capital is being increased to £80,000 for the extension of this undertaking.

The directors of the *Berliner Elektrizitäts Werke A.G., of Berlin*, which undertaking is now purely an investment company, state in their report for 1916-17 that the A.E.G. at present owns four-fifths of the ordinary share capital of £2,205,000, and they give a list of the securities held in various supply works. The net profits are returned at £243,000, as contrasted with £226,000 in 1915-16. After the payment of 4½ per cent. on the preference capital of £1,000,000, the balance permits of the distribution of 8 per cent. on the ordinary shares, as against 7 per cent. in the preceding year.

The report of the *Bayerische Stickstoff Werke A.G., of Munich*, which deals with the year ended on May 31st, 1917, states that the operation of the company's own works and of those under its management was influenced by the difficulties associated with the war, so that the full output was not reached in every case. A number of new plants for the production of carbide and of cyanamide were erected on the company's process for foreign account. After allocating £34,000 to depreciation, as against £46,000 in 1915-16, the accounts show net profits of £77,000, as compared with £73,000, and a dividend of 14 per cent. has been declared, being the same rate as in the previous year.

The financial statement of the *Elektrizitäts A.G. vorm. Schuckert & Co., of Nuremberg*, for the year ended July 31st, 1917, has been issued, and shows gross profits of £466,000, as compared with £516,000 in the preceding year, exclusive of £80,000 and £76,000 brought forward in the two years respectively. After deducting £171,000, as against £189,000 for general expenses, interest on loans, taxes and depreciation, and coupon tax, the accounts show net profits of £375,000, as contrasted with £403,000 in 1915-16. It is proposed to pay 8 per cent. on the share capital of £3,500,000, this rate comparing with 8 per cent., 6½ per cent., and 6½ per cent. in the three preceding years respectively.

The directors of the *Telephon Fabrik A.G. vorm. J. Berliner, of Hanover*, report an increased turnover in 1916-17 and the possession of large orders for the Government. In connection with the C. Lorenz Co., the company formed in Vienna an undertaking for electrical, physical and optical apparatus, and subscribed £20,000 as one-half of the share capital. The company was still without any reliable information concerning its foreign undertakings. After writing off £39,000 for depreciation, as against £31,000 in 1915-16, the accounts indicate net profits of £99,000, as contrasted with £123,000, and a dividend of 25 per cent. is proposed, as in the previous year. It is intended to increase the share capital by £125,000 to £375,000.

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**Dublin United Tramways (1896), Ltd.**—5 per cent. per annum (5s. per share) on ordinary shares for half-year; £7,000 to reserve and renewal fund; £15,000 for renewal of rails; £11,500 written off investments; £13,461 carried forward.

**Direct United States Cable Co., Ltd.**—Interim dividend of 2s. per share, less tax at 5s., being at the rate of 4 per cent. per annum, for the quarter ended December 31st.

**Water Softeners, Ltd.**—The accounts for the year ended June 30th, 1917, after writing off £583 for depreciation, show a profit of £4,748, which reduces the debit balance to be carried forward to £13,433.—*Financial Times.*

**Underfeed Stoker Co., Ltd.**—Interim dividend at the rate of 5 per cent., less tax, for 1917.

**Lima Light, Power & Tramways Co.**—Dividend of 1½ per cent. on the shares, less income-tax.

**Companies Struck Off the Register.**—The following have been struck off the register, and are dissolved:—

Cleartone Antiseptic Telephone Drum, Ltd.
Electrolysers, Ltd.
Electromechan, Ltd.
Metallic Alloys, Ltd.
Tyrone Power Co., Ltd.
Universal Electric Contracts, Ltd

**France.**—The Société Energie Electrique du Sud-Ouest, of Paris, is increasing its capital from £960,000 to £1,200,000.

**Kaministiquia Power Co.**—Dividend, 2 per cent. (at the rate of 8 per cent. per annum) on the common stock for the quarter to January 31st.

**Crompton & Co., Ltd.**—Warrants have been posted for a dividend on the preference shares at the rate of 7 per cent. per annum for the half-year ended September 30th, 1917.

## STOCKS AND SHARES.

TUESDAY EVENING.

THE strength with which Stock Exchange markets opened the New Year received further impetus from the speech of the Premier last week-end. This had a good effect all round the Stock Exchange, inducing buying in many departments, and infusing a sentiment of cheerfulness into the House as a whole. It quickened business not only amongst high-class securities, but in the industrial market as well, and a number of the best-class commercial shares stand higher on the week.

Electrical shares have not been overlooked in this connection. British Insulated rose to 3¼, India-Rubber shares to 14¼, and in those cases where prices have not been altered the difficulty is to buy shares, rather than to sell them. The disappointing market is still that for Home Railway stocks, where the gleam of strength imparted by a little investment after New Year's Day quickly gave place to a reaction amongst prices and a falling away of business, although the list has retained part of the improvement registered when the Stock Exchange restarted work on January 2nd. Undergrounds have come to the front during the past few days, and the Income Bonds of the big company are better at 82, while the 1s. shares put on a few pence at 5s. 3d. Metropolitans are 1 up, and in this connection it may be mentioned that London United Tramways 4 per cent. Debenture stock has gained a point at 36¼. Districts, however, are dull at 15¼.

Investors are, of course, putting as much money as they can into the various sources of war borrowing, but there are some who have sufficient money left over to average securities which they hold at higher prices, and there is something of a famine in the gilt-edged stocks in the Home Railway market. A few hundred pounds of Metropolitan District and London Electric 4 per cent. Guaranteed, which can be obtained at 69½, affords a return of 5 per cent. on the money. London Electric 4 per cent. Preference can be bought at 63, and District 4½ per cent. Preference at 69, giving returns of 6½ and 6⅝ per cent. respectively. There is a fair amount of Central London Guaranteed 4 per cent. Assented Preferred available at 62, offering an investor £6 11s. 6d. per cent. on his money.

The list of electrical supply shares is very steady, without, however, any change having occurred worth mentioning. We have discussed with various financial authorities the prospects of the industry as they may be modified in the light of the sub-committee's report on the coal conservation scheme. The consensus of opinion leans to the idea that the proposals for saving coal and money, put forward by the sub-committee, are likely to fare in practice no better than the various schemes drawn up to the same end in past years, and that the difficulty of obtaining anything like central control and organisation is greater than the sub-committee imagine. Therefore, from the point of view of practical politics, the scheme is regarded as interesting, but little more, and the likelihood of its having any effect upon shares in existing companies is scarcely discussed as within the province of present-day possibilities.

The recently-threatened strike amongst electrical workers was without influence upon market prices, the opinion being general that composure of the differences was only a matter of time.

The report of the British Columbia Electric Railway Co., summarised here last week, afforded satisfaction to the market and those intimately connected with this company. The results in the way of dividends were much about the same as had been anticipated, and, except for a little inquiry for some of the prior-charge stocks, no particular tendency followed the issue of the report. Anglo-Argentine Trams are still weak in consequence of the postponement of the dividend on the First Preference shares, but Brazil Tractions are a better market, thanks to the stronger tone that has developed amongst bonds of the Brazilian Government and various other securities connected with Brazil. The feeling towards Mexico also is rather more hopeful, and those who were deploring the fate of the utility companies as being sealed until the end of the war are beginning to ask whether there may not be something to "go for" before peace is signed. Of course, with prices so low as they are now, there are not many sellers, so that any little inquiry for stock exercises a sharply favourable effect upon prices. Mexico Tramways bonds of both classes are 5 points higher.

Astonishment is the prevailing sentiment in regard to the remarkable proposal placed before holders of Brisbane Electric Tramways shares by the authorities in Queensland. As things stand at present, the company can be taken over on a profits basis, but the calm suggestion is made that the company should reduce its fares (and therefore its profits) without alteration in the basis of its being taken over. Naturally the board have entered a strong protest against the injustice of such a plan, and we can hardly suppose that it will be ineffective. The incident is unfortunate, to say the least of it, and the price of the ordinary shares has fallen 10s. to 6½. Calcutta ordinary are better at 7, and the 5 per cent. debenture stock of the Electrical Supply of Victoria is 2 points up at 92.

Telegraph issues are quietly good, and Chile Telephones strengthened to 7½. Marconis recovered to 3 3/16, Americans to 25s. 9d. The armament group is harder. Rubber shares have shaken off most of their December dulness, and the copper market is also stronger. Chemical shares show an easy tendency, with Castner-Kellners 3/32 lower at 3 5/16. At the same price, Babcock & Wilcox are 1/16 to the good.

## SHARE LIST OF ELECTRICAL COMPANIES.

| | Dividend 1915. | Dividend 1916. | Price Jan. 8, 1918. | Rise or fall this week. | Yield p.c. |
|---|---|---|---|---|---|
| **HOME ELECTRICITY COMPANIES.** | | | | | |
| Brompton Ordinary | 1) | 9 | 6½ | — | £3 18 6 |
| Charing Cross Ordinary | 5 | 5 | 4 | — | 6 5 0 |
| do. do. 4½ Pref. | 4½ | 4½ | 3⅞ | — | 6 13 4 |
| Chelsea | 4 | 3 | 2⅞ | — | 6 9 1 |
| City of London | 5 | 5 | 13½ | — | 6 0 9 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10½ | — | 5 18 6 |
| County of London | 7 | 7 | 11 | — | 6 7 3 |
| do. 6 per cent. Pref. | 6 | 6 | 10½ | — | 5 18 6 |
| Kensington Ordinary | 7 | 6 | 8⅞ | — | 5 11 7 |
| London Electric | 3 | Nil | 1 | — | Nil |
| do. do. 6 per cent. Pref. | 6 | 4 | 8½ | — | 5 6 8 |
| Metropolitan | 3 | 3 | 3½ | — | 4 12 4 |
| do. 4½ per cent. Pref. | 4½ | 4½ | 6¾xd | — | 6 13 4 |
| St. James' and Pall Mall | 5 | 5 | 7 | — | 5 14 6 |
| South London | 5 | 5 | 8 | — | 6 13 4 |
| South Metropolitan Pref. | 7 | 7 | 21/8 | — | 6 10 6 |
| Westminster Ordinary | 7 | 7 | 6⅞ | — | 5 9 8 |
| **TELEGRAPHS AND TELEPHONES.** | | | | | |
| Anglo-Am. Tel. Pref. | 6 | 6 | 85½ | — | 6 5 6 |
| do. Def. | 3 1/8 | 1½ | 23⅛ | — | 6 8 4 |
| Chile Telephone | 8 | 8 | 7½ | + 1/8 | 5 10 4 |
| Cuba Sub. Ord. | 5 | 7 | 9½ | — | *7 11 4 |
| Eastern Extension | 8 | 8 | 13 | — | *5 6 8 |
| Eastern Tel. Ord. | 8 | 8 | 150½ | — | *5 6 4 |
| Globe Tel. and T. Ord. | 7 | 7 | 13½ | — | *5 1 10 |
| do. Pref. | 6 | 6 | 10½ | — | 5 17 1 |
| Great Northern Tel. | 22 | 24 | 80 | — | 6 11 6 |
| Indo-European | 13 | 13 | 69½ * | — | 6 3 10 |
| Marconi | 10 | 15 | 3 1/16 | + 1/16 | 4 14 1 |
| Oriental Telephone Ord. | 10 | 10 | 8 | — | 5 6 8 |
| United R. Plate Tel. | 8 | 8 | 6½ | — | *5 17 6 |
| West India and Pan. | 6d. | 6d. | 1 1/16 | — | *3 9 6 |
| Western Telegraph | 7 | 8 | 15½ | — | *5 5 0 |
| **HOME RAILS.** | | | | | |
| Central London, Ord. Assented | 4 | 4 | 60½ | — | 6 12 3 |
| Metropolitan | 1 | 1 | 23½ | + 1 | 4 6 6 |
| do. District | Nil | Nil | 15½ | + ½ | Nil |
| Underground Electric Ordinary | Nil | Nil | 1⅛ | — | Nil |
| do. do. "A" | Nil | Nil | 5/8 | +3d. | Nil |
| do. do. Income | 6 | 4 | 82 | +1 | *4 17 7 |
| **FOREIGN TRAMS, &c.** | Dividend 1915. | Dividend 1916. | | | |
| Adelaide Sup. 6 per cent. Pref. | 6 | 6 | 4⅞ | — | 6 3 1 |
| Anglo-Arg. Trams, First Pref. | 5½ | 5½ | 2½ | — | — |
| do. 2nd Pref. | 5½ | — | 2½ | — | — |
| do. 5 Deb. | 5 | 5 | 65½ | —1 | 7 11 8 |
| Brazil Tractions | 4 | 4 | 45 | —1 | — |
| Bombay Electric Pref. | 6 | 6 | 9⅜ | — | 6 4 |
| British Columbia Elec. Rly. Pfce. | 5 | 5 | 42½ | — | 11 15 4 |
| do. do. Preferred | Nil | Nil | 30 | — | Nil |
| do. do. Deferred | Nil | Nil | 28 | — | Nil |
| do. do. Deb. | 4½ | 4½ | 56 | — | 7 11 |
| Mexico Trams 5 per cent. Bonds | Nil | Nil | 32½ | +5 | Nil |
| do. 6 per cent. Bonds | Nil | Nil | 34½ | +5 | Nil |
| Mexican Light Common | Nil | Nil | 17⅛ | — | Nil |
| do. Pref. | Nil | Nil | 20 | — | Nil |
| do. 1st Bonds | Nil | Nil | 32½ | — | — |
| **MANUFACTURING COMPANIES.** | | | | | |
| Babcock & Wilcox | 15 | 15 | 3 3/16 | + 1/16 | 4 14 6 |
| British Aluminium Ord. | 7 | 10 | 11⅝ | — | 6 5 9 |
| British Insulated Ord. | 17½ | 20 | 3⅛ | + ¼ | 6 8 3 |
| British Westinghouse Pref. | 7½ | 7½ | 2 1/16 | — | 5 11 4 |
| Callenders | 20 | 20 | 14½ | — | 6 18 0 |
| do. 5 Pref. | 5 | 5 | 4 | — | 6 5 0 |
| Castner-Kellner | 22 | 20 | 3 5/16 | — 3/32 | 6 1 8 |
| Edison Swan, fully paid | — | — | 2½ | — | Nil |
| do. do. 4 per cent. Deb. | 4 | 4 | 75½ | — | 5 6 0 |
| Electric Construction | 7½ | 7½ | 1½ | — | 6 13 4 |
| Gen. Elec. Pref. | 5 | 5 | 10½ | — | 5 17 2 |
| do. Ord. | 10 | 10 | 19½ | — | 5 1 8 |
| Henley | 25 | 25 | 10½ | — | 7 11 6 |
| do. 4½ Pref. | 4½ | 4½ | 4 | — | 5 13 3 |
| India-Rubber | 10 | 10 | 14½ | + ½ | *6 18 0 |
| Telegraph Con. | 20 | 20 | 41½ | — | *5 15 7 |

* Dividends paid free of income-tax.

## NATIONAL ELECTRICITY SUPPLY.

### INTERIM REPORT OF THE COAL CONSERVATION SUB-COMMITTEE.

(*Concluded from page 8.*)

While it might be feasible for local concerns, whether municipal or company, to retain, as seperate bodies, the ownership of mains and the business of supplying lighting and small power consumers, the generation and main transmission and distribution of electrical energy, and the business of supplying power to manufacturers, railways, and other large users, must, in each industrial district, be in the hands of one organisation. If the lighting and small power business were left in the hands of the existing authorities, arrangements would have to be made by the Commissioners, in settling the terms between the new authorities and the existing authorities to ensure the consumer getting the benefit of any reduction in the price of electricity consequent on generation on a large scale. There can be no question, however, that if the criterion upon which this matter has to be settled is the price of electricity and the conservation of coal, the arguments in favour of handing over the whole business to the new authorities predominate.

The proposal to link up adjacent power stations is a step in the direction of greater economy, and should be encouraged, provided it is appreciated that it is only a step. As a permanent solution it is not effective, for first, it is impossible to run a large number of linked-up stations at the highest economy unless they are under the same ownership and control, and, secondly—and more important—where such stations are under separate control a linking-up scheme, pure and simple, tends rather to perpetuate the uneconomical station than the reverse.

It has been frequently proposed as an alternative to mere linking up that bodies should be created which would deal solely with bulk supply, existing authorities being compelled to take all further electrical energy beyond what they can generate in their present stations from the new bulk supply system, and being allowed to run their existing stations as far as they desire to do so far a period of years. The disadvantages are that it would take much longer to make a change over to economical generation on account of the tendency of the existing bodies to wish to keep their own plants. The delay in the transfer of the load would prevent the greatest economies being effected. When the transfer was complete, the existing bodies would be left with indifferent plants which had become obsolete.

If the existing stations were owned or operated by different bodies they would not be of so much use for stand-by and peak-load purposes as they might otherwise be.

On the other hand, wherever there is unity of ownership and control, not only are all the advantages of linking-up secured, but the erection on correct lines of all further generating plant required is assured.

If a comprehensive system of electricity supply were inaugurated it may be confidently stated that, on the basis of the extent to which power is used at present, a saving of 55 million tons of coal per annum can be expected. Taking the value of this coal for export purposes as 10s. per ton, the national annual advantage of the change, available for interest on capital, is, say, £27,500,000 in coal alone. Alternatively, if this 55 million tons of coal were used for extended and new industrial processes, some 15,000,000 H.P. continuously throughout the year would be available for the purpose.

This saving of £27,500,000 per annum takes no account of the following additional and important advantages which would directly result from the establishment of an efficient electric power supply system throughout the country:—

1. A reduction in the cost of transport in carrying coal.
2. A possible saving in coal consumption for domestic purposes (the consumption for which purpose is now probably 55 million tons per annum).
3. The reduction in the cost of coal handling involved in house-to-house delivery and general coal distribution.
4. The great advantages and economies which would result from the more extended use of electricity in the household for heating, cooking, and cleaning purposes in the way of labour-saving devices, reduction of smoke, increased cleanliness, &c.
5. The possibility of utilising the coal at present left in the pits or otherwise wasted.
6. The possibility of extracting by-products, &c., before consuming the coal for power purposes.
7. The increase in railway electrification, with its attendant advantages, which a comprehensive electric power supply system would render commercially possible and profitable.

All these savings and advantages taken together show a total possible national advantage which can hardly be put at less than £100,000,000 per anum, apart from the manufacturing and industrial advantages of a cheap and efficient electric power supply.

It may be asked why it is that the so-called power companies have not had a greater effect in developing power supply on correct lines.

The more one considers the matter and examines the facts the more clear does it become that the so-called "Power Act" legislation was faulty in certain important respects. In the result the electric lighting authorities in the majority of important districts have, from their point of view, succeeded in practically stopping the growth of the power companies, except in one or two cases. Not only has the price of electricity throughout the country been maintained at altogether too high a figure as a result of the perpetuation of an inefficient system, but the large and ample power supply has not been made available, to the great disadvantage of the nation at the present crisis and for future industrial development.

In order to secure, even on existing lines of development, the more correct extension of electricity undertakings as the demand grows, it has been proposed to appoint electricity commissioners. Recommendations have been made by the Power Companies' Association to Sir Charles Parsons's Committee on this matter, and it is understood that their report will deal with it.

What is required is not only the appointment of commissioners, but the instruction to them to arrange in each district for the establishment of one electricity body owning and operating the electricity supply system, this body, except possibly for dealing with lighting and small power consumers, to take over all existing stations and mains, running the whole electric power supply system for the district, and at once making arrangements for the generation of power on a large scale, preferably from super-stations, erected also for dealing with the new processes already referred to.

This raises the question as to whether in arranging for such new body to take over the electricity supply business in any given area the business should be dealt with by the State, by municipal enterprise, by private enterprise, or by a combination of these. As it may be useful to consider the different alternatives possible, brief reference to them is made in an Appendix.

An analysis of the existing situation in the industrial areas of the country indicates that there are very different conditions in the different areas as regards municipal ownership. In some of the areas the important plants are almost entirely owned municipally, and in one or two areas the power companies already are commencing to own the whole business. It would, therefore, appear that one solution is not necessarily applicable to every area, and there might be advantages from a national point of view in allowing development in some districts on one line and some on another.

What is essential is that the national policy should be changed.

The aim in the future must be to concentrate under one authority for each industrial district, firstly, the main distribution system—that is to say, what may be called the main trunk electric roads—and, secondly, the responsibility for the location of the generating machinery in the most economical positions.

#### RECOMMENDATIONS.

1. It is essential that the present inefficient system of over 600 districts should be superseded by a comprehensive system in which Great Britain is divided into some 16 districts, in each of which there should be one authority dealing with all the generation and *main* distribution.

2. Centres, or sites, suitable for electric generating purposes should at once be chosen on important waterways as the future main centres of supply for each of the districts into which the country is to be divided.

3. The sites so chosen should be as large as possible, having in view the land available in suitable localities, and should have ample water and transport facilities. Land is required not only for the power stations themselves—which for the sake of security and safety would have to be suitably subdivided, that is, they would not be contained all in one building—but for the processes involved in the extraction of by-products from the coal before it is used for the production of power, where such extraction is found to be justified. It is also required for the development of electro-chemical processes, which may be most conveniently carried on in close proximity to the power plant. This condition entails the sites being chosen outside, not inside towns. (The health of the great industrial centres and the congestion of the railway lines in their neighbourhood would be radically improved by arranging that the conversion of coal into motive power was carried out away from the densely populated centres.)

4. Plans should be prepared for the construction immediately after the war on these sites of the first instalment of large super-power plants capable, first, of supplying, through a comprehensive electric power distribution system which must also be arranged for, the existing demands of the community; and, secondly, of supplying electrical energy at the lowest possible price for new processes and manufactures.

5. Such plants would be designed so that, as methods are perfected for extracting by-products from the fuel, before using it for the purpose of the production of electric power, the by-product plant can be combined with the power plant. Each site should be laid out with this in view, and with a view to the unrestricted extensions of the plant as required.

6. Power available from surplus gas or waste heat should be turned into electrical energy on the spot in local plants which would feed into the main distribution system. As regards waste coal—*i.e.*, coal which it does not at present pay to bring to the surface—this could, where transport was the ruling consideration, also be used on the spot.

7. Once these plants are in existence it would be possible for existing authorities, without any risk of being left in the lurch, to stop extensions of their own uneconomical stations, situated as they mostly are on cramped and unsuitable sites, and to arrange to take their power from the main system.

8. With a view to carrying out the policy advocated a Board of Electricity Commissioners should be appointed, with full powers to deal with the electricity supply situation throughout the country. They should have power, *inter alia*,

(*a*) To stop the extension or multiplication of uneconomical stations for public supply.

(*b*) To arrange for the handing over, on equitable terms, of the generation, transmission and main distribution system in each of the areas into which the country is to be divided, to a new electricity body appointed for that area.

(*c*) To standardise for each area the frequency and voltage of the main transmission and distribution system.

(*d*) To settle for each area whether such body should consist of a Parliamentary company working under adequate control as regards limitation of dividends, &c., or one of the other alternatives given in the Appendix.

9. Alternative types of the new electric power organisations are described in the Appendix. In reference to these alternative types the Sub-Committee are impressed with the special need for initiative and resource in the management of the business of power supply, and they are of opinion that the freedom of range and keenness which are distinctive of private enterprise will be found to be in a high degree conducive to the fullest measure of success. The Sub-Committee consider that if the nation is to get immediately an efficient power supply, and is to take advantage of the temporary lull in manufacturing output immediately after the war, State assistance in some form may be necessary.

## APPENDIX.

ALTERNATIVE TYPES OF ELECTRIC POWER ORGANISATIONS.

In considering the composition of the proposed new bodies to deal with the supply of electricity in each of the areas into which the country should be divided a number of alternatives present themselves, namely :—

(*a*) A combination of all companies and local authorities in each industrial district (as defined by the Commissioners).

(*b*) Where there is already a power company (statutory) in the area, all the other electricity undertakings, both company and municipal, to be taken over by the power company on terms arranged by the Commissioners.

(*c*) Where at present the supply is dealt with by a number of comparatively small undertakings, both company and municipal, but where the company undertakings predominate, a new company to be formed, possibly by an amalgamation of existing companies, to which the whole of the undertakings in the area would be transferred.

(*d*) Where the supply is dealt with as in (*c*) but the company concerns do not predominate, and where local feeling is strongly against a purely company scheme, a local board to be formed, representing both company and municipal interests, and under the control of the Commissioners, which would be invested with full powers to take over and carry on the whole of the undertakings, both municipal and company, in the area.

(*e*) Public or joint ownership as in (*d*) with company operation.

It is taken for granted that under any of these alternatives the Electricity Commissioners would have power to fix maximum prices and a sliding scale of prices and dividends, and to control the terms upon which capital should be raised, &c.

(*a*) *Combination of all Existing Undertakings.*—Although every one of the undertakings in the area, whether company or municipal, might admit that only by combination and concentration can economy be obtained, the attempts which have been made in the past to bring about a combination of existing concerns have shown that the interests are so conflicting that they cannot be reconciled by the interested parties acting alone. It is true that agreements for exchange of electricity have been made, but all attempts to bring about central control have failed.

(*b*) *Power Company to take over all Undertakings.*—A power company having been formed for the purpose, and equipped with the necessary statutory powers, appears at first sight to be the right body to entrust with the business of supplying the whole of the industrial district in which its own area of supply is situated; and where the power company is already established on a sound commercial and technical basis, and has shown by its development in the past that it understands its business, this method is probably the best (see the report of Lord Cross's Committee).

The statutory powers of power companies carry with them such obligations as have been found to be ample to protect the interests of the community, but if further safeguards, in addition to the control by the Electricity Commissioners, were desired, they could be imposed by Parliament.

(*c*) *New Company.*—Where no power company exists, or where the power company has not developed any very large business, a new company might be formed to take over all the existing undertakings. Local private enterprise might be encouraged to assist in the formation of the new company, with the guidance of the Electricity Commissioners, who should also settle the terms upon which the new concern would take over and carry on the business, and the statutory powers required, which would be embodied in a special Act on the lines of the present Power Acts.

(*d*) *Local Electricity Board.*—In an area where municipal enterprise predominated, the establishment of a company to take over everything, both municipal and company, might create local feeling which would be detrimental to the business. On the other hand, a purely municipal concern would be equally impracticable, since the claims of county councils, city corporations, and urban and rural district councils could scarcely be reconciled. A local board appointed by the State, subject to the control of the Electricity Commissioners, appears to be the only alternative available if private enterprise is to be ruled out. The objection to such a method is, of course, the usual objection to all purely State undertakings, namely, that they are without incentive for the proper pushing of the business, which in the case of power supply requires enterprise and resource if the best results are to be obtained, not only for the power supply business, but for the consumer and for the nation.

(*e*) *Public or Joint Ownership with Company Operation.**—By this method economy in capital and interest charges is secured, whilst the commercial development of the business on proper lines is secured by the incentive of bigger profits which the operating company would have, subject, of course, to the safeguards against high prices in the form of a sliding scale of dividend and prices—auction clauses, &c.

## WEST OF SCOTLAND LINKING-UP.

THE report of the West of Scotland Committee for the interconnection of electric supply undertakings, to which we made a brief reference last week, divides the local authorities and companies within the specified area into the following groups :—

Group A.—Paisley, Greenock, and Kilmarnock Corporations, and Kilmarnock Electric Co.

Group B.—Glasgow Corporation Electricity and Tramways Departments and the Clyde Valley Electric Power Co.

Group C.—Alloa, Falkirk, and Stirling Corporations; the National Electric Construction Co., Bo'ness; and the Scottish Central Electric Power Co., near Falkirk.

Group D.—Lanarkshire Tramways, Motherwell and Hamilton Corporations, and Lanarkshire County Council, Cambuslang. Within this area there are also a number of private plants, a supply in substitution for which would be the business of the public supply undertakings concerned.

In regard to Group A, interconnection would necessitate a link of 3,750 K.V.A., for Greenock-Paisley, and a further 1,875 K.V.A. link to Kilmarnock, at a cost of £75,000, with a resultant economy of £5,900 per annum; with Kilmarnock omitted the cost becomes £47,300, and the estimated saving £5,200. The Committee considers that linking-up between these centres is not a commercial proposition at the present time.

Group B.—Approximate units generated, 281,000,000; coals used, 376,337 tons; coal costs, £299,115; average used per unit, 3.0 lb.; per ton, 15s. 11d. The three undertakings in this group furnish supplies at a periodicity of 25 cycles. Two of these are already linked up to some extent, and the committee has been informed by the managers that it is only necessary to install from 4,000 to 6,000 KW. of static transformers at the Dalmarnock station of the Glasgow Corporation to provide a link of maximum utility at a cost of about £16,000. Assuming that full advantage is taken of the interconnection between the three, and allowing a small average increase in economy of 0.1 lb. of coal per unit generated, the annual saving would approximate £10,000.

Group C.—Approximate units generated, 17,070,000; coal used, 32,845 tons; coal costs, £22,503; average used per unit, 4.3 lb.; per ton, 13s. 8d. The undertakings here all generate direct current, with the exception of the Scottish Central, whose system is three-phase, 50 cycles, and a portion of Falkirk Corporation supply, which is similar.

It is generally agreed that linking-up would have to be *viâ* the Scottish Central Co.'s mains. The combined week-end load of the group does not exceed 2,000 KW., and could be comfortably carried by the Scottish Central; an expenditure of £16,000 would be involved, and a saving of about £1,000 per annum made.

Group D.—The undertakings generate 8,985,000 units; coal used, 21,754 tons; coal cost, £13,031; average coal per unit, 5.4 lb.; price per ton, 12s. The undertakings all generate direct current, and have similar load characteristics; linking-up is not justified, but future requirements should be met by H.T. bulk supply.

In addition, the question of linking-up between groups has also been considered, and the following conclusions arrived at :—

* Co-operation between municipal and private enterprise in the electricity supply business has had some success in Germany.—*See* Consular Report No. 635 on the Supply of Electricity in Germany—Cd. 7,049. A scheme embodying this principle has actually been worked out in some detail by the L.C.C. for dealing with London. Its progress was stopped by the outbreak of war, but the reports and papers relating to it are of considerable interest.

Group E (A and B).—The only practical manner in which these groups might be linked up would be by means of a link between Clyde Valley (25 periods) and Paisley (50 periods). Calculating on a link of 1,000-KW. capacity, the total cost of mains, rotary machinery, &c., was found to be approximately £12,870, while the annual saving to be expected from the interchange of energy would not exceed £1,040.

Group F (B and D).—The undertakings in Group D are all within the Clyde Valley area, and the Lanarkshire tramways are already supplied from the Clyde Valley Co. at several points. Linking up these groups would involve the extension of the Clyde Valley Co.'s mains to each of the undertakings in Group D, and the provision of rotary machinery and switchgear would cost approximately £15,000. Assuming a supply to be given at week-ends, the fuel saving would be equivalent to £1,200 per annum. There would be other advantages, but the Committee considers that linking up for the single purpose of week-end supply to the stations in Group D from the Clyde Valley Co. cannot in the meantime be recommended.

Group G (B and C).—The linking up in these two groups resolves itself into a question of interconnecting the Clyde Valley system (25 cycles) with the Scottish Central (50 cycles). Having regard to the distance between the systems, and more particularly to the difference in periodicity, necessitating rotary machinery at a new station and special staff, linking up is not recommended. The Scottish Central system, however, is of the same periodicity as the Fife Power Co., whose area of supply is included in the East of Scotland area in the map issued by the National Electric Power Supply Joint Committee, and it is therefore suggested that the district served by these two undertakings would be better considered as a separate area, making three areas in the Scottish section.

Thus, omitting the capital and saving involved in Group B, the total capital involved in linking-up would be £118,870, and the estimated saving £9,140 per annum.

Much greater fuel economy would be realised by linking-up where conditions were favourable for the purpose of a supply in bulk from the larger to the smaller undertakings, and the Committee recommends that this aspect be further investigated.

## TRADE STATISTICS OF THE STRAITS SETTLEMENTS.

THE following statements, showing the imports (not for transhipment) of electrical and other materials into the various Straits Settlements ports in 1916, are taken from the recently-issued official trade statistics. In compiling these statistics the first port of shipment is generally accepted as denoting the country of production. The values for 1915 are added for purposes of comparison, with notes of any increases or decreases.

### IMPORTS INTO SINGAPORE.

| | 1915. Dollars. | 1916. Dollars. | Inc. or dec. Dollars. |
|---|---|---|---|
| *Telegraph and telephone materials.*— | | | |
| From United Kingdom ... | 389,000 | 692,000 | + 303,000 |
| ,, United States ... | — | 18,000 | + 18,000 |
| ,, Sweden ... ... | — | 22,000 | + 22,000 |
| ,, Other countries ... | 16,000* | 14,000 | − 2,000 |
| Total ... ... | 405,000 | 746,000 | + 341,000 |
| * Australia $2,000. | | | |
| *Tramway and railway materials.*— | | | |
| From United States ... | 165,000 | 88,000 | − 77,000 |
| ,, United Kingdom ... | 77,000 | 95,000 | + 18,000 |
| ,, Other countries ... | 13,000 | 3,000 | − 10,000 |
| Total ... ... | 255,000 | 186,000 | − 69,000 |
| *Electrical machinery.*— | | | |
| From United Kingdom ... | 219,000 | 232,000 | + 13,000 |
| ,, Germany ... ... | 2,000 | — | − 2,000 |
| ,, Italy ... ... | 5,000 | 13,000 | + 8,000 |
| ,, Netherlands ... | 17,000 | 5,000 | − 12,000 |
| ,, United States ... | 13,000 | 16,000 | + 3,000 |
| ,, Japan ... ... | 8,000 | 15,000 | + 7,000 |
| ,, Other countries ... | 23,000 | 30,000 | + 7,000 |
| Total ... ... | 287,000 | 311,000 | + 24,000 |
| *Engines, boilers, and parts.*— | | | |
| From United Kingdom ... | 266,000 | 339,000 | + 73,000 |
| ,, Sweden ... | — | 100,000 | + 100,000 |
| ,, United States ... | 8,000 | 51,000 | + 43,000 |
| ,, Other countries ... | 27,000* | 38,000 | + 11,000 |
| Total ... ... | 301,000 | 528,000 | + 227,000 |
| * Denmark $5,000. | | | |
| *Lamps and lampware.*— | | | |
| From Netherlands ... | 18,000 | 17,000 | − 1,000 |
| ,, Germany ... ... | 17,000 | — | − 17,000 |
| ,, United Kingdom ... | 45,000 | 73,000 | + 28,000 |
| ,, United States ... | 6,000 | 9,000 | + 3,000 |
| ,, Japan ... ... | 15,000 | 64,000 | + 49,000 |
| ,, Other countries ... | 15,000 | 28,000* | + 13,000 |
| Total ... ... | 116,000 | 191,000 | + 75,000 |
| * Sweden $8,000. | | | |
| *Machinery, other (except sewing machines).*— | | | |
| From United Kingdom ... | 502,000 | 699,000 | + 197,000 |
| ,, Australia ... ... | 36,000 | 25,000 | − 11,000 |
| ,, United States ... | 65,000 | 288,000 | + 223,000 |
| ,, Other countries ... | 116,000 | 170,000* | + 54,000 |
| Total ... ... | 719,000 | 1,182,000 | + 463,000 |
| * Japan $22,000. | | | |

### IMPORTS INTO PENANG.

| | | | |
|---|---|---|---|
| *Electrical machinery.*— | | | |
| From United Kingdom ... | 44,000 | 55,000 | + 11,000 |
| ,, United States ... | — | 4,000 | + 4,000 |
| ,, Denmark ... ... | 2,000 | 5,000 | + 3,000 |
| ,, Other countries ... | 6,000 | 4,000 | − 2,000 |
| Total ... ... | 52,000 | 68,000 | + 16,000 |
| *Engines, boilers, and parts.*— | | | |
| From United Kingdom ... | 163,000 | 247,000 | + 84,000 |
| ,, Australia ... ... | 33,000 | 3,000 | − 30,000 |
| ,, United States ... | — | 165,000 | + 165,000 |
| ,, Netherlands ... | 5,000 | 5,000 | — |
| ,, Other countries ... | 4,000 | 15,000 | + 11,000 |
| Total ... ... | 205,000 | 435,000 | + 230,000 |
| *Machinery, other (except sewing machines).*— | | | |
| From United Kingdom ... | 88,000 | 90,000 | + 2,000 |
| ,, United States ... | 18,000 | 14,000 | − 4,000 |
| ,, Other countries ... | 8,000 | 42,000* | + 34,000 |
| Total ... ... | 114,000 | 146,000 | + 32,000 |
| * Malay States $33,000. | | | |
| *Lamps and lampware.*— | | | |
| From Japan ... ... | 5,000 | 24,000 | + 19,000 |
| ,, United Kingdom ... | 28,000 | 54,000 | + 26,000 |
| ,, Other countries ... | 8,000 | 8,000 | — |
| Total ... ... | 41,000 | 86,000 | + 45,000 |
| *Telegraph and telephone materials.*— | | | |
| From United Kingdom ... | — | 6,000 | + 6,000 |
| *Tramway and railway materials.*— | | | |
| From United Kingdom ... | 2,000 | 9,000 | + 7,000 |
| ,, United States ... | — | 2,000 | + 2,000 |
| ,, Holland ... ... | 1,000 | — | − 1,000 |
| Total ... ... | 3,000 | 11,000 | + 8,000 |

### IMPORTS INTO MALACCA.

| | | | |
|---|---|---|---|
| *Telegraph and telephone materials.*— | | | |
| From United Kingdom ... | 2,000 | 3,000 | + 1,000 |
| *Engines, boilers, and parts.*— | | | |
| From United Kingdom ... | 5,000 | 4,000* | − 1,000 |
| * Entered through Malay States. | | | |
| *Electrical machinery.*— | | | |
| From United Kingdom ... | 1,000 | — | − 1,000 |
| *Machinery, other (except sewing machines).*— | | | |
| From United Kingdom ... | 18,000 | 67,000 | + 49,000 |
| ,, Other countries ... | 11,000* | 2,000 | − 9,000 |
| Total ... ... | 29,000 | 69,000 | + 40,000 |
| * Federated Malay States $10,000. | | | |

N.B.—Dollar = 2s. 4d.

**Hamburg Electricity Works in Difficulties.**—The following notice appeared in *Hamburger Nachrichten* on December 4th :—" Owing to breakdown (Betriebsstörung) in a power station of the Hamburg Electricitäts-Werke, it is essential that all motor loads be disconnected until further notice between the hours of 4 p.m. and 9 p.m. It is, therefore, strictly forbidden to run motors during this period. In case of infringement of this order, the offending installation will be disconnected from the lighting network." It will be interesting to learn the precise nature of the trouble which has necessitated such a stringent order.

## THE RÖNTGEN SOCIETY.

### A NEW PORTABLE X-RAY TUBE CONSTRUCTION.

AT the meeting of the Röntgen Society, on January 1st, Mr. Carl Darnell, representing Mr. W. D. Coolidge, of the Schenectady Laboratories, demonstrated a new radiator type of hot-cathode X-ray tube, and also a portable X-ray generating outfit to accompany it. He said that these had been developed in America specifically for use at the Front, where portability was a chief consideration. The electrical efficiency of existing portable X-ray generating outfits was low, but it could be greatly increased if a suitable tube were forthcoming for operating directly from the secondary of a high-pressure transformer without the use of any auxiliary rectifying device. The existing type of hot-cathode tube —*i.e.*, the ordinary Coolidge tube—might fulfil this condition, but it would require the use of a large focal spot, which was a disadvantage for radiographic purposes. The essential condition was that heat should be more rapidly withdrawn from the focal spot than was the case with the ordinary Coolidge tube, and the device of water-cooling whereby this might have been done would have interfered with the portability. Experiment proved that the most effective and simple method was to build a target with a large heat capacity and high heat conductivity, and then to provide that the mass of metal should be cooled at the time when the tube was to be given its full load. The anode of the new tube, therefore, consisted as to its stem of a solid bar of copper, which was brought right out through the glass of the anode arm to a copper radiator. The head of the anode consisted of a very small wrought tungsten button set in a solid block of specially purified copper, which was electrically welded on to the stem. The tungsten button designed to receive the cathode-ray bombardment was 0·1 in. in thickness and ⅜ in. in diameter. The complete target with the radiator had a heat capacity considerably greater than that of the present standard solid tungsten target, and the tube, therefore, for a given milliamperage and voltage could be operated several times as long as the other before the target was brought to red heat. But an even greater advantage was the fact that, between radiographic exposures, the target in this new tube cooled comparatively rapidly, owing to the delivery of the heat to the external radiator. And whereas the older tubes radiated a great deal of their energy through the glass of the walls, which became quite hot, in this new tube the larger part of the energy imparted to the target was conducted out to the radiator, so that it was possible to make the glass bulb very small. Actually for portable work a bulb diameter of 3½ in. had been standardised. The passage of inverse current was avoided in this tube also by the construction which removed heat from the focal spot so rapidly that, in normal use, it never reached the temperature at which appreciable thermionic emission of electrons took place. The first model of this new tube had been designed to carry 10 ma. at a 5-in. parallel spark gap for a sufficient time to make the most difficult radiographic exposure, and, for screening purposes, to carry a load of 5 ma. at 5-in. parallel spark gap continuously for an indefinite period.

Two portable X-ray generating units, which were also demonstrated, have been built round this tube model, and are being used in the United States Army. In both of them the tube is operated directly from a high-voltage transformer, with no auxiliary rectifying device. A second paper by Mr. Coolidge and Mr. Moore described this unit in detail, and stated that after considering various types of apparatus, a gasoline-electric set was adopted, furnishing alternating current to a step-up transformer, with the self-rectifying X-ray tube operating directly from the latter. This gasoline-electric set delivered alternating current at about 45 cycles and 120 volts to the step-up transformer. The advantages of the outfit were control of line voltage, making it possible to duplicate electrical conditions and X-ray results very accurately, and the absence of moving parts other than the gasoline set itself. The new apparatus was discussed by a large number of members, one of whom compared the innovation to that of the Kodak in photography.

## NEW PATENTS APPLIED FOR, 1917.

### (NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electric Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

19,046. "Electric lamps." T. W. CAIRNS. December 24th.

19,050. "Overhead trolleys or collectors for electric tramway or railway vehicles." W. REES & C. O. TAYLOR. December 24th.

19,063. "Spring terminals for electric accumulators." FULLER ACCUMULATOR Co. & A. P. WELCH. December 24th.

19,064. "Electric safety-lamp cases." FULLER ACCUMULATOR Co. & A. P. WELCH. December 24th.

19,065. "Manufacture of carbon electrodes." C. H. THOMPSON. December 24th.

19,082. "Diaphragms for electrolytic cells." CHEMISCHE FABRIK WEISSENSTEIN & R. WALTER. December 24th. (Austria, December 19th, 1916.)

19,090. "Rectifier for wireless telegraphy." J. F. MILLER. December 27th.

19,096. "Controllers of direct-current electric motors for hoisting and lowering apparatus, &c." ELECTRIC CONTROL, LTD., & S. THOMPSON. December 27th.

19,098. "Sparking plugs for internal-combustion engines, &c." J. E. GIMBERT. December 27th.

19,099. "Telephone transmitters." A. MARR. December 27th.

19,108. "Electromagnetic methods of detecting submarines." R. BEATTIE. December 27th.

19,110. "Electric cable junction fittings." A. M. LOVETT, A. C. MANIFOLD AND E. G. PYNE. December 27th.

19,123. "Sparking plug ignition wire clip for rotary aero engines, &c." W. OSWIN. December 27th.

19,126. "Electric insulators." SOC. CERAMICA RICHARD-GINORI. December 27th.

19,131. "Means of control for searchlights, &c." W. A. STEVENS. December 27th.

19,135. "Pocket electric lamp." A. P. R. DARDELET. (France, December 2nd.) December 27th.

19,150. "Telephone and microphone receivers." C. TEASDALE-BUCKELL. December 28th.

19,159. "Self-engaging cog for electric machines." R. H. LANE. December 28th.

19,170. "Electrolytic preparation of metals or alloys in the form of paste, sludge, or sponge." B. LEECH, AND H. & L. SLATER. December 28th.

19,176. "Focusing incandescent electric lamps for optical projection purposes." F. C. JENKINS. December 28th.

19,191. "Electric switches." H. N. DAVIS & W. R. TWIGG. December 28th.

19,195. "Safety devices for interlocking operating parts of enclosed switch, &c., gear with door or doors of enclosing casing." J. A. HIRST. December 29th.

19,239. "Interrupters or contact-breakers for magneto-electric machines." A. M. ALLEN & R. B. NORTH. December 29th.

19,240. "Chain electric welding machines." BRITISH INSULATED & HELSBY CABLES, LTD., & P. BUCHER. December 31st.

19,252. "Sparking plugs for internal-combustion engines." J. HILL. December 31st.

19,280. "Party-line ringing systems." WESTERN ELECTRIC Co. (Western Electric Co., U.S.A.) December 31st.

19,290. "Electric systems for motor vehicles, &c." BIJUR MOTOR LIGHTING Co. December 31st. (U.S.A., April 30th.)

19,304. "Sparking plugs for internal-combustion engines." L. LAVOISIER. December 31st.

19,322. "Electric heating apparatus." A. J. ALLEN & L. V. LEONARD. December 31st.

19,351. "Alternating-current electromagnet." D. C. LARSON. December 31st.

## PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

### 1916.

9,055. ELECTRIC FURNACE FOR STEEL MELTING. S. Steinberg & I. Gramolin. June 27th, 1916. (111,679.)

9,408. ELECTRIC HAND LAMPS. J. W. Manley. July 20th, 1917. (111,680.)

15,500. CONSTRUCTION OF DYNAMO-ELECTRIC MACHINES. Sandycroft, Ltd., R. L. Cleaver & H. E. Potts. October 31st, 1916. (111,689.)

15,803. CONTACT BREAKERS FOR MAGNETOS. Soc. Anon. Appareillage Electrique Grivolas. December 27th, 1915. (102,936.)

17,260. PORTABLE TELEPHONE AND SIGNALLING APPARATUS. H. C. Crews. December 1st, 1916. (111,694.)

17,277. ELECTRIC SWITCHES. H. C. Widlake. December 1st, 1916. (111,695.)

17,450. ELECTRIC LIGHTING SYSTEMS APPLICABLE TO VEHICLES. H. A. Gill (U.S. Light & Heat Corporation). December 5th, 1916. (111,704.)

17,528. DYNAMO-ELECTRIC MACHINERY. E. S. G. Rees & W. Armistead. December 6th, 1916. (111,709.)

17,626. DYNAMO-ELECTRIC GENERATORS AND REVERSING MECHANISM THEREFOR. J. Stone & Co. and A. H. Darker. December 7th, 1916. (111,718.)

17,701. ELECTRIC WATER OR OTHER LIQUID HEATERS. J. S. Langford. January 14th, 1916. (103,475.)

17,856. CONTROL OF ELECTRIC MOTORS. J. M. L. Slater. December 12th, 1916. (Cognate application, 84/17.) (111,723.)

17,996. SELECTION OF ELECTRIC CURRENTS. A. Perego. December 14th. 1916. (111,728.)

18,223. DEVICE FOR DEMONSTRATING TO CLASSES OR INDIVIDUALS THE RELATION BETWEEN TRUE AND MAGNETIC BEARINGS. W. J. N. Fairley. December 20th, 1916. (111,732.)

18,386. METHOD OF ENERGISING AERIAL CONDUCTORS FOR WIRELESS SIGNALLING AND OTHER PURPOSES. G. Plaisant. December 22nd, 1916. (111,735.)

### 1917.

1,555. ELECTROLYTIC PRODUCTION OF METAL WIRE AND STRIP. S. O. Cowper-Coles. January 31st, 1917. (111,757.)

2,106. DEVICE FOR TESTING MAGNETOS AND SPARKING PLUGS. E. Morgan. February 12th, 1917. (111,760.)

2,439. TEMPERATURE COMPENSATORS FOR ELECTRICAL CONTROL DEVICES. British Thomson-Houston Co. (General Electric Co., U.S.A.) February 19th, 1917. (111,764.)

2,624. OIL-BREAK ELECTRIC SWITCHES. R. W. Gregory & Electrical Improvements, Ltd. February 22nd, 1917. (111,766.)

3,160. MANUFACTURE OF CLAY, PLUMBAGO AND OTHER LIKE ARTICLES BY ELECTRO-DEPOSITION ON METAL MOULDS. B. J. Allen. March 3rd, 1917. (Addition to 2,252/17.) (111,775.)

5,898. MEANS FOR CLEANING THE SPARKING PLUGS OF INTERNAL-COMBUSTION ENGINES AND THE LIKE. J. H. Andrew. April 26th, 1917. (111,794.)

6,399. MOUNTING AND INSULATING OF THE CONTACT PARTS OF ELECTRIC SWITCHES. H. H. Berry. May 4th, 1917. (111,796.)

11,036. ELECTRIC CIRCUIT CONTROLLERS. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.) July 31st, 1917. (Patent of addition not granted.) (111,812.)

11,579. SPARKING PLUG TESTER. W. Hanman. August 11th, 1917. (111,813.)

13,098. RESISTANCE SWITCHES FOR CONTROLLING THE INTENSITY OF ELECTRIC CURRENTS. J. Watkinson & W. Adams. September 12th, 1917. (111,821.)

13,551. TROLLEY WIRE SYSTEMS FOR USE ON ELECTRIC RAILWAYS, TRAMWAYS AND THE LIKE. P. Dawson & F. W. Fawdry. September 20th, 1917. (111,822.)

16,756. ELECTRIC LIGHTING SYSTEMS APPLICABLE TO VEHICLES. H. A. Gill (U.S. Light & Heat Corporation). December 5th, 1916. (Divided application on 17,450/16.) (111,833.)

**Russian Electrical Regulations.**—In view of the project of law prepared by the Ministry of Trade and Industry on granting freedom to private contractors in the matter of installing electrical conductors and constructing installations, the chief Board of Local Economy proposes to draw up a series of rules for the purpose of protecting the interests of districts and towns from capitalistic contractors in the matter of electrical transmission.